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# HYGIENE OF THE EYE

BY

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*120 ILLUSTRATIONS*

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# PREFACE

Sight is the most valuable of all the special senses and the author has endeavored to convey in the following pages, in language as free from technicalities as possible, how it may best be conserved, and the relation which the organ of vision bears to the general economy. Although general practitioners are doubtless more or less familiar with the substance of its contents, it is thought that a review of the more common diseases of the eye, with a description of the manner in which the eye is affected by the general health, and also how the latter may be influenced by eye-strain, will not be without value, both to the physician engaged in general practice and the general public.

Vision plays such an important part in education that the chapters dealing with the refraction of the eye, the illumination and equipment of the school-room, and the general care of the eyes of the scholar should invite the interest of teachers and parents.

Blindness and the diseases and conditions leading to it are fully discussed in its pages, together with the national movements which are being made towards its prevention; all of which the author hopes may lessen the labors of those who are so unselfishly leading the movement to diminish the number of blind in this country.

In view of the increasing number of ocular injuries received by workmen in foundries, factories and elsewhere, particular attention is given to this important subject, as well as to the best means of preventing them—information which should be of value to those engaged with the problem of lessening the number of industrial accidents.

It is hoped by the author that the contents of the four chapters written by distinguished specialists in the subjects which they discuss may prove of interest to ophthalmologists as well as to general practitioners and laymen, as they contain information which should be of value to the specialist hitherto not available in condensed and popular form. Otherwise the author fears his professional colleagues will find the work elementary and falling far short of what a comprehensive treatise on ocular hygiene treated fully from a scientific standpoint should be. He bespeaks their co-operation, however, in his attempt to convey to the popular reader a broader comprehension of the various phases presented by ocular anomalies and diseases.

In conclusion, the author desires to express his obligation to the National Committee for the Prevention of Blindness, for the loan of a number of photographs, notably those illustrating the chapter on wounds and injuries.

THE AUTHOR

2049 Chestnut Street,
Philadelphia, Pa.
June 1, 1918

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# HYGIENE OF THE EYE

## CHAPTER I

## STRUCTURE OF THE EYE AND OF THE PARTS ADJOINING

To render the descriptions of the various affections which will be treated of in the following pages more comprehensible, it has seemed desirable to give some introductory account of the anatomy and physiology of the eyes and their appendages. Naturally, any attempt at a complete or technical description of either of these subjects would be foreign to the scope of this treatise, and an effort will be made to present them in the briefest manner compatible with clearness.

Such a delicate organ as the eye necessarily demands most careful protection, not only from external injury, but also from diseases of contiguous structures. Against the former, nature has amply provided by furnishing a bony framework into which the eye is set, so that only its anterior one-third is exposed, and even this portion has the covering of the lids and the interlacing eye-lashes, to protect it when occasion demands. To give expression to the workings of the mind, and to endow the countenance with charm and intelligence, the exposed part of the eye has been made the most beautiful of all the structures of the body and has well earned the designation of the poet as "the mirror of the soul."

The bony receptacles in which the eyes are lodged, *the orbits,* are cone-shaped, with their widest portion directed forward, and as the long axis of each cone is more divergent at its opening than at the apex, a maximum of rotation is afforded to the eyes as they are pulled in various directions by the action of the group of muscles with which each is provided (Fig. 1). In addition to the eyeball and its muscles, the orbit contains a thick bolster of fat, which surrounds the globe, protecting it from injury and permitting of its free rotation by the ocular muscles. The configurement of the orbit depends in large measure upon the shape of the skull and varies in different individuals and in different races, being shallow in races with skulls short in the anteroposterior axis, as exemplified in the Indian, and deep where the same axis is elongated, as may be noted in many European skulls. As the shape of the orbit determines in large measure the form of the eyeball, and, as we will see later, the state of the refraction in each eye is dependent upon its length, it follows that near-

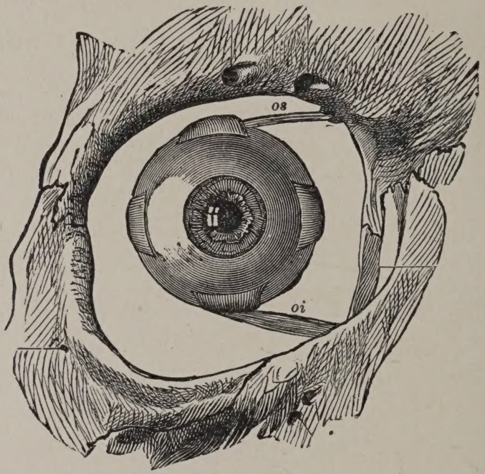


Fig. 1.—Anterior orifice of the orbit with the eyeball. Natural size. The tendons of the four recti muscles are cut off near their insertion upon the eyeball, but the interior oblique, *oi*, and the tendon, *os*, of the superior oblique are left entire.

sightedness and far-sightedness are often the expression of racial peculiarities of structure.

While the walls of the orbit are thin, to give less weight to the skull, their margins are dense and strong, to receive the force of blows. This is particularly true of the upper margins, where the protective power of the brow is further augmented by a cushion of hair, the eyebrow, which is formed of muscle and thick skin, covered with stiff hairs. The brow forms a conspicuous setting for the eye and enters largely into facial expression. It also affords protection, by shedding perspiration.

With but one exception, *the external muscles of the eye,* six in number, arise from the apex of the orbit and are attached to the globe near its equator. This arrangement permits of the free movement of the eye in all directions, while the one muscle which has its origin near the opening of the orbit is concerned chiefly with its easy rotation (Fig. 2). These muscles receive their stimuli from nerves which, together with the principal blood-vessels, gain access to the orbit through a fissure in the apex of the orbit. Another hole in the same position, the optic foramen, permits the passage of the optic nerve with the chief retinal blood-vessels into the skull. The muscles of both eyes work in perfect harmony with one another, and, by means of a wonderful complex mechanism of correlated activity, rotate the eyes, either subconsciously or at the will of the individual, in all directions. Any considerable incoordination in their action is productive of double vision, and the nice parallelism which is maintained by the perfect balance of all the muscles is destroyed and the affected eye turns or squints (see p. 52).

The *eyelids* when closed form a perfect curtain for the eye, and when open an attractive setting for the organ of vision. The lashes, with their graceful curve, are decorative as well as protective to mechanical injury, and when the lids are partially closed, their interlacing without excluding vision serves as a protection against excessive light. They attain their maximum growth in about five months and then drop out, being succeeded by new ones. Inflammatory conditions of the edge of the lids sometimes cause the incoming lashes to assume a wrong direction and to turn inward against the eye. They are then commonly known as " wild hairs," and cause great distress and may even give rise to serious inflammation of the eyeball. Assuming that other inflammatory conditions of the eye which are attended by sensations of pricking and irritation are also caused by wild hairs, it happens not infrequently that the ignorant pull out their lashes in the hope of obtaining relief from the annoying symptoms, a use-

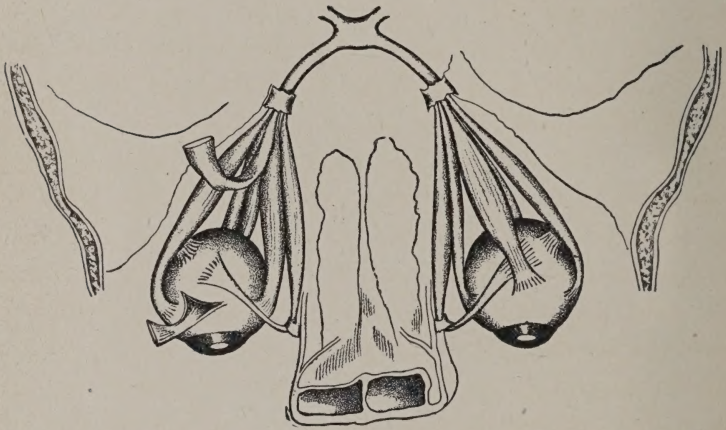


Fig. 2.—Muscles of the right orbit. ("Motor Apparatus of the Eye," Stephens, Courtesy F. A. Davis Co.)

less procedure, as the lashes in such instances are not at fault.

The movements of the lids are performed almost entirely by the upper, the lower being almost stationary. Upon the width of the opening between the lids depends the apparent size of the eye and the expression of the individual. Racial characteristics find expression in the almond eye of the Mongolian. In certain diseases of the eye and the nervous system, the upper lids droop, giving an expression of drowsiness and frequently necessitating the throwing back of the head to enable the rays of light to gain entrance to the pupils.

The eyelids, which are composed of muscle, elastic tissue, and plates of cartilage which give form and firmness to the lids, are covered by skin, which is but loosely attached to the sublying tissues. This laxity of the superficial tissues accounts for the great swelling which frequently attends inflammations or follows injury of these structures, and permits of the puffiness under the lower lids which frequently accompanies diseases of the heart and kidneys.

The thin, delicate tissue, *the conjunctiva,* which covers the anterior part of the globe and also lines the lids, is continually lubricated by tears derived from *the lachrymal gland,* a secreting organ the size of a filbert, hidden under the outer portion of the roof of the orbit, and by mucus derived from the conjunctiva itself and from a series of small glands embedded in the edge of the lids. After lubricating the eye and the conjunctival sac, the secretions are sucked by two small apertures situated upon the inner portion of each lid into the tear sac, with which they are connected by two fine tubes. This sac, the size of a small pea, is situated just below the ligament which connects the lids with the orbit, so that its emptying is facilitated not only by the contraction of its own muscular coat, but also by the tension exerted upon it by the ligament of the lids during the act of winking. The lachrymal sac empties into the nose, through a bony canal at the lower inner portion of the orbit. This canal and sac are lined by a mucous membrane continuous with that of the nose and

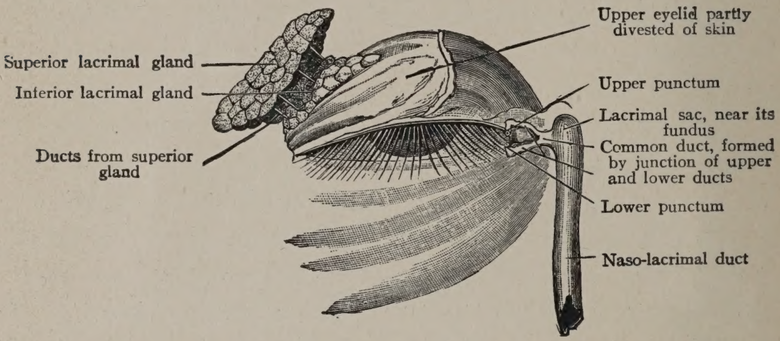

Upper eyelid partly divested of skin
Superior lacrimal gland
Inferior lacrimal gland
Upper punctum
Lacrimal sac, near its fundus
Common duct, formed by junction of upper and lower ducts
Ducts from superior gland
Lower punctum
Naso-lacrimal duct

FIG. 3.—The lachrymal apparatus. ("Modern Ophthalmology," Ball, F. A. Davis Co.)

of the conjunctival sac, which accounts for the sympathetic watering of the eye in so many nasal affections (Fig. 3).

The eye itself is spheroid in form and about an inch in diameter, being somewhat longer in its anteroposterior than its vertical axis. It is suspended in the orbit by its muscles and by a series of membranes or fascia to the walls of the surrounding orbit. The layer of fat referred to above fills out the remaining orbital space.

The outer layer, or envelope, *the sclerotic,* is a firm, opaque, tough membrane, into the anterior part of which the transparent cornea is set. The sclerotic maintains the form of the eyeball and serves for attachment of the muscles which move the eye. That portion immediately surrounding the cornea and which is alone visible, forms the so-called " white of the eye," the rest being hidden behind the conjunctiva and orbital tissues. *The cornea* is also tough and resisting, but perfectly transparent, to permit the passage of rays of light into the eye (Plate I). It may be designated as " the window of the eye." Its outer surface is smooth and preserves a high degree of polish, and, being curved, returns, as a convex mirror, an erect image of diminished size of any object before it.

Lying within the sclerotic, is *the choroid,* a membrane rich in blood-vessels and pigment. The blood-vessels nourish the interior of the eye and the pigment aids in the absorption of excessive light. The quantity of pigment varies, being plentiful in brunettes and sparse in blondes. In albinos it is entirely absent. The choroid does not extend quite so far forward as the sclerotic, and merges anteriorly into the ciliary body.

The third and essential coat is *the retina.* This is a delicate sheet of nervous tissue, continuous with the brain, through the medium of the optic nerve and its cerebral prolongations, and the rest of the eye may be regarded merely as a mechanism for its protection and means of exposure to external impressions (Fig. 4). The light-perceiving elements of the retina are arranged in ten distinct layers, held together by a connective-tissue framework. The most important layer is that of the rods and cones, the latter elements being especially concerned in the perception of visual sensations, as these bodies are alone represented in the macular region, a very minute area upon which the rays concerned with the most direct and acute vision are focussed. External to the layer of rods and cones is the pigment layer, in which is stored the retinal purple, a photochemical substance which absorbs light and is concerned in the transformation of the rays into visual impulses. Just what the nature of this transformation is has not been clearly determined, but, of course, there is no actual picture capable of perception by another person formed there.

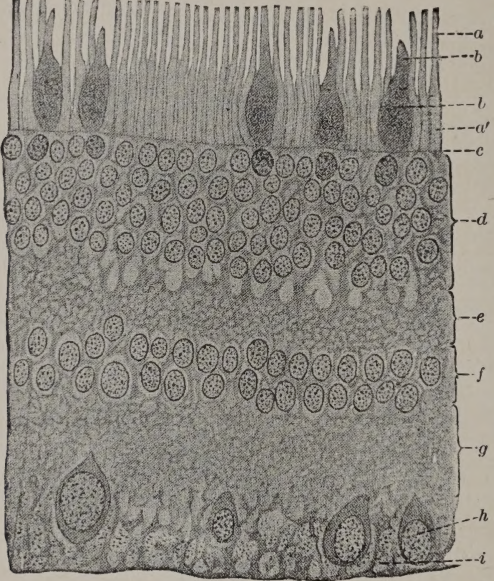


Fig. 4.—Section of human retina (Böhm and v. Davidoff): *a*, *a′*, outer and inner segments of rods; *b*, *b′*, outer and inner segments of cones; *c*, membrana limitans externa; *d*, outer nuclear layer; *e*, outer plexiform layer; *f*, inner nuclear layer; *g*, inner plexiform layer; *h*, layer of ganglion cells; *i*, fibre layer. Magnified 700 diameters.

The claim sometimes made, therefore, of the possibility of detecting by posthumous examination of the retina the object last regarded before death, is extravagant and absurd.

The remaining portions of the eye are adapted to the proper focussing of the rays of light entering the eye through the cornea upon the retina, and in the regulation of the amount of light entering the eye. The chief of these is *the crystalline lens* (Fig. 5). This structure is a double transparent convex lens or ordinary magnifying glass, but of such consistency that its convexity may be readily altered. It consists of connective layers composed of minute fibrils, the outermost layers, or cortex, being softer than at the central zone, or nucleus. As age advances, the lens becomes harder and more resistant. It is contained within an elastic covering and is suspended in the anterior part of the eye by a delicate ligament, a fine transparent structure of fibrous tissue, and surrounded by a small circular structure, *the ciliary body,* the termination of the anterior extremity of the choroid coat. This body is divided into two portions, a circular band of muscular tissue, the ciliary muscle, and the ciliary processes. These latter, 60 or 70 in number, merge with the anterior portion of the choroid and possess the power of pulling that membrane forward. The ciliary body is a structure of great importance, as will appear later, for upon its action depends the alteration in the shape of the crystalline lens and the changing focus of the eye.

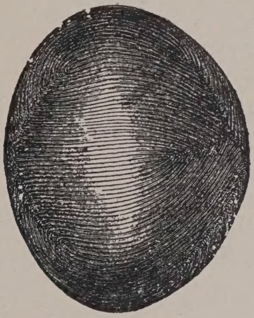


FIG. 5.—Crystalline lens of new-born child, seen from the side, showing the course of the lens fibres. (Arnold.) Magnified 6 diameters.

The lens rests posteriorly in a cup-shaped depression in *the vitreous humor,* a transparent gelatinous structure which occupies four-fifths of the interior of the ball. This humor fills out the form of the eyeball and gives support to the retina, spread over its outer surface.

The amount of light entering the eye is regulated by means of a circular curtain, *the iris,* its central aperture forming the pupil. The iris lies upon the front of the lens, its base of support and action being at the margin of the posterior surface of the cornea, and the anterior portion of the ciliary muscle. In addition to muscle fibres, the iris contains pigment, the quantity of which determines the color of the eye, the designation of the eyes as gray, blue or black depending upon that factor. In albinos, the pigmentation of the iris is absent, and the pinkish hue is dependent upon the reflection through it of the red blood in the vessels of the choroid. All eyes are blue at birth, the commencement of permanent coloration taking place about the sixth week. There is no truth in the popular idea that dark eyes are stronger than light ones, except in so far as they are better protected against excessive light. It is a wise provision of Nature, that among Southern races dark eyes prevail, the better to protect against the glare of a tropical sun, while in the North, light eyes predominate.

The circular aperture in the iris, *the pupil,* is adapted for the transmission of light into the eye, its size constantly varying in response to variations in the quantity of light which falls upon it. The change in the shape of the pupil is effected by a double set of muscles in the iris, one of circular fibres, contracting to make the pupil small in the light, and one of dilating powers, to enlarge the pupil in darkness. The pupil varies in size in different individuals, and at different ages, growing smaller as age advances. The pupil is larger, also, in near-sightedness than in far-sightedness. Local affections within the eye, as well as diseased conditions elsewhere in the body, affect its size; various drugs have the same power also.

The space between the iris and lens and the arching surface of the cornea is filled with *an aqueous humor,* which has some refracting properties. The cornea and vitreous also possess like qualities. These are constant, and but slight in comparison with those of the lens.

The eyeball is richly supplied with blood-vessels and nerves, apart from the great nerve of sight, the optic, and it is by means of some of these latter that the change in the size of the pupil is accomplished, acting under stimuli from the brain centres. The chief source of vascular supply to the retina is by means of a small artery which enters the eye through the centre of the optic nerve. In case of sudden stoppage of this vessel by a clot, instant blindness ensues.

## CHAPTER II

## THE PHYSIOLOGY OF VISION—THE OPHTHALMOSCOPE

Of all the special senses, sight, perhaps, is the most valuable and highly prized. It comprises the perception and translation of impressions derived from external objects into cerebral conceptions. The explanation of the visual act must therefore include the manner by which impulses are conveyed from the exterior to the brain centres, and something at least regarding the nature of the impressions. How physical impulses are transformed into vision we cannot say, nor have we, indeed, any knowledge of other kinds of perceptions.

From an optical standpoint, all objects in nature are divided roughly into luminous and non-luminous bodies; light emitted from the former or reflected from the surface of the latter moves in straight lines, and the smallest conceivable line of light is called a ray. Of these rays we will speak more hereafter. It will suffice at this time to say that the great function of the eye is to collect these rays from surrounding bodies, to focus them upon one of its parts, the retina, whence the impressions are conveyed along the optic nerve and higher brain tracts to the various visual centres. The eye, therefore, resembles in its action a photographer's camera, of such intricate and wonderful construction that it is always exposed for the receipt of impressions from all distances, and can act either alone or in harmony with its fellow, with a swiftness and accuracy that no mechanical device can even approach, much less equal.

In the camera, images of external objects are focussed upon a sensitive plate and become permanent in consequence of chemical changes induced by light; in the eye, they fall upon the retina, where, after undergoing biochemical change, they are conveyed to the visual centres in the brain by the optic nerve. The eyeball itself, therefore, does not see, the act of vision being performed by the brain. Figs. 6 and 7 compare the mechanism of a camera with that of the eye. The sclerotic represents the sides

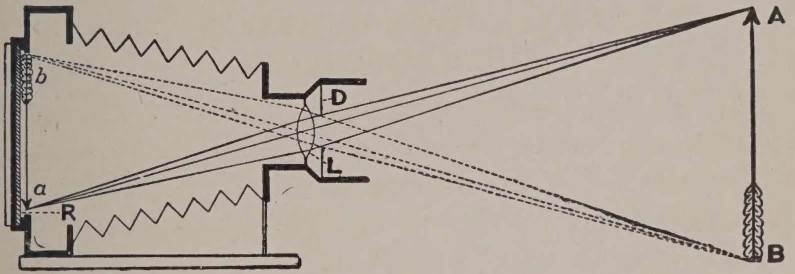


Fig. 6.—Camera obscura of a photographic apparatus. *AB*, object; *D*, diaphragm for shutting off too divergent rays; *L*, lens for refracting the rays so that they will form the image *ab* upon the sensitive plate *R*.

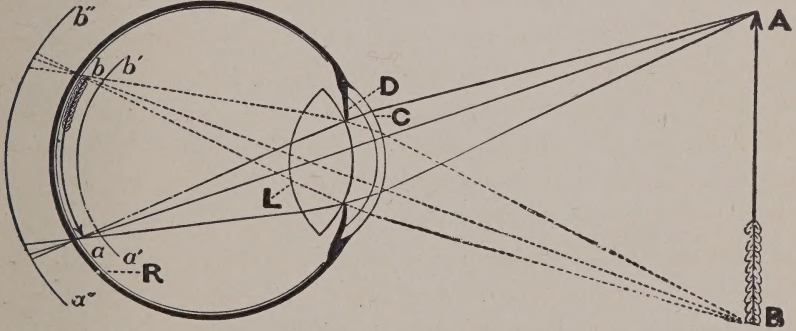


Fig. 7.—The eye as a camera. *AB*, object; *C*, cornea, where the rays undergo a first refraction; *D*, the iris, that acts as a diaphragm for shutting off too divergent rays; *L*, lens, where the rays are again refracted; R, retina, upon which the image *ab* is projected; *a′b′* represents the surface of a hypermetropic eye, and shows that the rays are not completely focussed, and consequently the image must be blurred and indistinct; *a″b″* represents the surface of a myopic eye, and shows a similar condition.

of the box, the choroid its blackened inner surface, the pupil forms the opening, and the crystalline lens and cornea the focussing lens (*e*). The iris serves as a diaphragm. The rays of light fall in the one case on the sensitive plate, in the other on the retina. As the rays of light cross in the eye, the retinal picture is an inverted one, just as is the image in the magic lantern. The transposition of the image doubtless occurs in the brain, though there are some who assert that the righting process takes place in the retina itself.

LENSES.—A lens may be defined as a portion of glass or other substance capable of transmitting light rays bounded by one or more curved surfaces. Lenses that are thickest at the centre are designated as convex lenses, those thinnest at the centre as concave lenses. Convex lenses have the property of collecting light rays, concave lenses of dispersing them. According to the degree in which they divert rays from their original source, lenses are designated as strong and weak, the former bringing rays quickly to a focus, the latter having their focus at a greater distance. The standard now universally adopted in the notation of

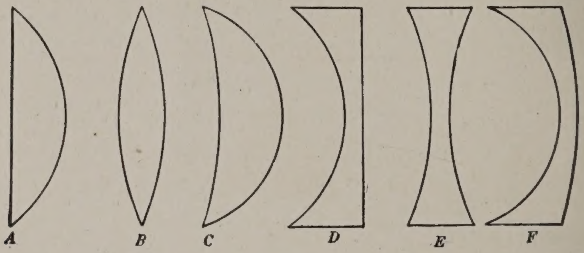


FIG. 8.—*A*, *plano-convex:* one side convex, the other plane. *B*, *double convex:* both sides convex. When both sides are equally convex, as represented in the figure, the lens is called *biconvex*. *C*, *concavo-convex:* one side concave, the other more convex. *D*, *plano-concave:* one side concave, the other plane. *E*, *double-concave:* both sides concave. When they are equally concave, as in the figure, the lens is called *biconcave*. *F*, *convexo-concave:* one side convex, the other more concave. Either *C* or *F* is called a *meniscus*, or periscopic lens.

lenses is based upon the metric system and the unit from which the gradations in the strength of lenses is reckoned is the Dioptre, *i.e.*, the focussing power required to bring parallel rays to a focus at the distance of 1 metre. A lens with twice this strength is designated as a 2 D. lens, and has a focal distance of one-half metre. An 0.50 D. lens is one with a focal distance of 2 metres (Fig. 8).

Lenses may be either spheric or cylindric. In the former, light is refracted equally in all its planes, in the latter, in one meridian only.

Prisms.—By a prism is meant a section of glass consisting of two plane surfaces so inclined to each other that they form an angle. As it is the property of prisms to deviate rays of light from the apex toward the base of the prism, a prism placed before either eye with its base toward the nose will deflect rays of light entering the eye, and lessen convergence effort (Fig. 9). Prisms may be ground into the lens, correcting any kind of refraction error, and as their base may be placed at any axis, and their strength accurately prescribed, they form one of the most valuable means of correcting eye-strain in the oculist's armamentarium. Prisms are not only of service in removing the strain from weak muscles, but are often employed in exercising such muscles, the base of the prism in

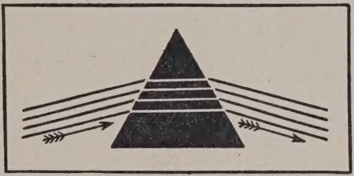


Fig. 9.—Passage of parallel rays through a prism.

such cases being opposed in direction to the action of the muscle which is to be strengthened.

All luminous rays reflected from a source at a distance greater than 15 or 20 feet are considered to be parallel. When the object from which light is reflected is brought nearer, rays entering the eye are divergent and require to be more strongly bent or collected before they focus upon the retina. This focussing property, of bending parallel rays of light from the distance and diverging rays from near objects so that they meet upon the retina, is termed refraction.

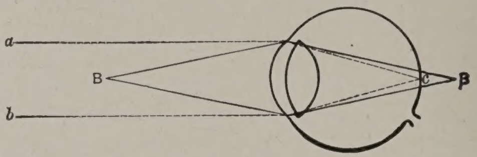


Fig. 10.—An emmetropic or normal eye. Parallel rays *a* and *b* are focussed upon the retina, while divergent rays, as those proceeding from the point *B*, come to a focus behind the retina.

All eyes are not of equal length, some being shorter and some longer than the average, or what may be considered to be the standard, eye. According, therefore, to this variation in length, oculists designate by the term *emmetropic, the eye of normal length* (Fig. 10), in which rays of light entering the eye from a distance are brought to a focus exactly on the retina. By *the hypermetropic or far-sighted eye* (Fig. 11) is meant too short an eye, one in

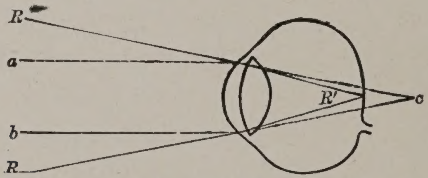


Fig. 11.—A hypermetropic or far-sighted eye. Parallel rays converge behind the retina. Rays must be *convergent* in order to focus there.

which similar rays of light are brought to a focus behind the retina, and *by myopic or near-sighted eye* (Fig. 12), too long an eye is designated, one in which the rays from a distance are focussed in front of the retina.

Not only may eyes vary in length, but, owing to a lack of uniformity in the curvature of the cornea, different meridians of the same eye have a different focus. In this refractive condition, which is termed *astigmatism,* rays of light which pass through the meridian of greatest convexity are brought to a focus sooner than those passing through the meridian of least curvature. According to the degree of corneal asymmetry, the type of astigmatism may vary. In simple astigmatism, for example, one of the meridians is emmetropic, the other hypermetropic or myopic. In compound astigmatism, both meridians are faulty, but unequal in degree. In mixed astigmatism, one meridian is hypermetropic, the other myopic.

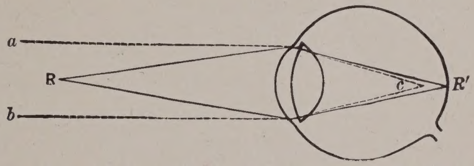


FIG. 12.—A myopic or near-sighted eye. Parallel rays converge before reaching the retina. Rays must be *divergent* in order to focus there.

ACCOMMODATION.—In describing the various parts of the eye, the crystalline lens was designated as a transparent biconvex lens, enclosed in a fibrous capsule, adaptable to change of shape, by action of the circular structure which surrounds it, the ciliary body. Unlike the camera, whose lenticular focal distance may be changed by movement of the sensitive plate backwards and forwards, the length of the eyeball is fixed and constant, and alterations in its focussing power performed by a change in strength of the refracting surfaces within the eye (Fig. 13). As has been stated, light rays coming from a distance greater than 15 or 20 feet are parallel; those emanating from an object situated nearer are divergent. To change the focus of the eye, therefore, from the perception of distant objects to those for near, its refracting power must be increased, and the convexity of the crystalline lens increased by action of the ciliary muscle. This adaptability of the eye is known as *the power of accommodation,* and is made use of whenever there is the slightest change in the distance of any near object we look at. As life advances, accommodation steadily declines. At 30 years of age, half of its power is gone and at 45 years it is so weakened that small objects near at hand are not perceived without additional focussing power. At 60 years, accommodation is practically *nil.* This decline in power is due to the increasing hardness in the lens already referred to, in consequence of which the ciliary muscle loses its power to increase its convexity. This loss in power of accommodation due to advancing years is termed *presbyopia or old sight.*

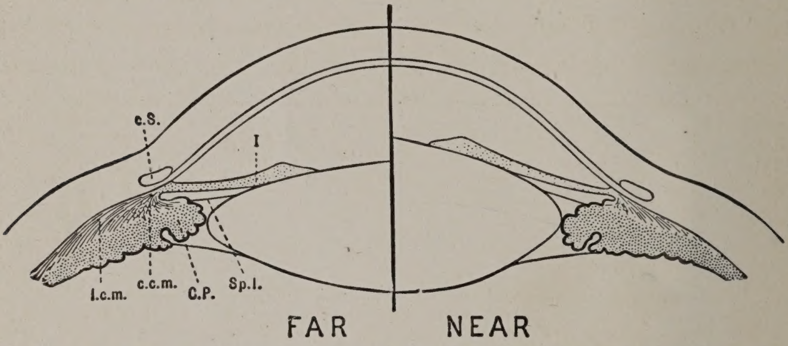


Fig. 13.—Diagram to illustrate accommodation (after Helmholtz). *C.P.*, ciliary process; *I*, iris; *Sp.l*, suspensory ligament; *l.c.m.*, longitudinal ciliary muscle; *c.c.m.*, circular ciliary muscle; *c.S.*, canal of Schlemm. The left half represents the arrangement for viewing far objects and the right half for viewing near objects. (Foster's "Text-book of Physiology," The Macmillan Company.)

Visual Acuity.—The normal acuteness of vision has been determined to be the power the eye has of distinguishing objects which subtend an angle of 5′ upon the eye. With this as a basis, Snellen, a distinguished Dutch ophthalmologist, constructed a series of letters made to conform to this standard. The accompanying diagram (Fig. 14) demonstrates that an object, in order to subtend the same angle, must be larger the farther it is removed from the eye. In conducting the test for visual acuity, a card containing graduated series of letters of different sizes is placed 6 metres distant from the observer and record made of the smallest line of letters which the observer is able to distinguish with each eye separately. If vision is normal, the line of letters designated as No. 6 will be distinguished without difficulty. Lower degrees of acuteness indicate some error in refraction or disease of the eye or of the centres of sight in the brain. In general, the visual acuity is expressed by a fraction, the numerator of which is the distance at which the test is conducted, the denominator, the line of type designated, *i.e.*, vision 6/12 means that the acuity is but one-half of normal, the line marked No. 12 on the card being seen at a distance of 6 metres.

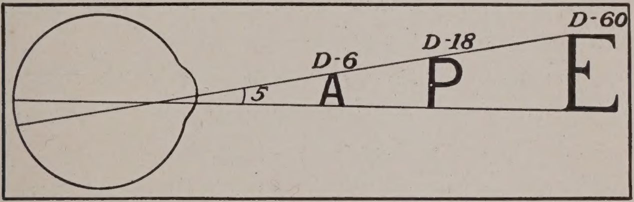


Fig. 14.—These types are so designed that the largest type should be seen at 60 metres by the normal eye, and the types range from this down to a size visible not farther off than 6 metres.

The Field of Vision.—Thus far we have been concerned with a description of direct vision, with the focussing and refraction of rays which entered the eye in its principal axis and are brought to a focus upon the centre of the retina, the macula lutea, so-called. Though less sensitive, the periphery of the retina is also capable of receiving impressions and transmitting them through the retina to the optic nerve and thence to the brain. This peripheral perception is termed indirect vision, and by it the eye is made conscious of objects outside the area of direct vision. The area embraced by direct and indirect vision is designated as *the field of vision,* and varies in extent according as the eye is directed upon a near or far object. By means of this function, there is a visual consciousness of a wide area of objects seen indirectly, and when this area is lessened by disease within the eye or impairment of the visual tracts and centres governing vision, the perceptive powers of the individual are greatly restricted.

If an individual station himself with his back to a window at a distance of two feet from a screen, and with one eye blindfolded direct his gaze upon his finger pressed against the screen directly in front of his eye, while with his free hand he brings a small square of white paper from the extreme periphery slowly inwards towards the finger point at which the eye is directed, the first conscious appearance of the paper will determine the extent of his visual field in that particular meridian, and if this procedure be repeated until all the meridians encircling the fixing finger be tested, he may map out roughly the entire extent of his visual field. If small pieces of colored paper are then substituted for the white, he will obtain the dimensions of what is termed *the color field.* This will be noted to be peripherally smaller than that for white, and if some designation of the point at which the colors are first seen is recorded on the screen, it will be noted that these are not all seen at the same point, but that blue will be perceived before red and red before green, etc.

Defects in the visual field may vary from loss of the entire field of indirect or peripheral vision, with the conservation of that of the central or fixation point alone, to the production of *small blind areas or scotomas,* scattered throughout the field. These minute blind spots, produced by disease, must not be confused with the physiological blind spot (Mariotte's blind spot) which corresponds to the position of entrance of the optic nerve within the eye, and which is situated somewhat to the outer side and below the fixation point.

Loss of half of the field of vision, termed hemianopsia, especially when associated with a corresponding loss in the fellow eye, is very significant of brain disease, and in association with a speech defect often follows apoplectic attacks. Blindness in the outer halves of the field of vision of both eyes is significant of disease of the pituitary body, and is often seen in connection with giantism and certain sexual characteristics.

Each eye not only possesses its own field of vision, but one in common with the fellow eye. The simultaneous use of both eyes is called binocular vision, and it is by the harmonious blending of images focussed upon corresponding parts of the two retinæ that the brain receives but a single impression. By means of binocular vision, we are enabled to form a much better impression of distances and of the form or solidity of objects. The accompanying diagram (Fig. 15) demonstrates the area of the combined fields of vision.

The determination of the extent of the visual field, more accurately determined, and registered by an apparatus termed *the perimeter,* is in common use by all oculists and is of inestimable value, not only in determining the nature and extent of intra-ocular diseases, but also the location of many affections within the brain which affect the centres of sight.

Ocular Muscles.—The range and extent of the field of vision is greatly increased by the rotation of the eyes by the extra-ocular muscles. Each eye moves in perfect unison with its fellow, and always with the maintenance of symmetrical points of the retinal images. If this harmonious action of the muscles moving the eyes be disturbed, single vision is no longer possible, and double vision results, usually with some apparent deviation of the eyes from the normal parallelism of their axes. In other words, the eyes are crossed. This is observed in paralyses of one or more of the eye muscles, such as occurs in consequence of some serious local or systemic disease.

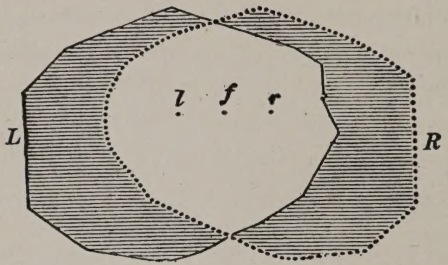


Fig. 15.—Binocular field of vision. (Möser.). The line *L* bounds the field of vision of the left eye, the line *R* that of the right eye. The central white area *l f r* marks the field of vision common to both eyes.

Less serious but often no less disturbing phenomena are occasioned much more frequently by slighter anomalies in the structure or nerve supply of the ocular muscles. In this class of cases, *the heterophorias,* so-called, there is no apparent departure from the harmonious dual action of the eyes, and single vision is still maintained. This maintenance of single vision and the avoidance of double vision is attained, however, only after severe effort upon the part of the weak muscles, and a chain of symptoms is evoked which is designated under the term of muscular weakness or muscular asthenopia. Dizziness, headache, digestive disturbances, and ocular discomfort at all distances, are some of the subjective symptoms evoked by these latent muscle errors. A consideration of true cross-eye, squint, or strabismus will be given later.

## THE OPHTHALMOSCOPE

Prior to 1851, the interior of the eye had never been explored and there was no knowledge of the conditions which interfered with vision other than those apparent by inspecting the anterior segment of the eye. In this year, however, von Helmholtz, the great physicist, produced an instrument termed the ophthalmoscope, by means of which it became possible to illuminate the fundus or back part of the eye, and to study under considerable magnification the many diseased conditions which were formerly the subjects of theoretical speculations. This discovery was undoubtedly one of the greatest achievements in physical science, and, as will presently be learned from the description of what the ophthalmoscope unfolds, has been of incalculable benefit to medicine.

*The ophthalmoscope* consists primarily of a concave silvered mirror with a central perforation, behind which are placed a number of convex and concave lenses set into a disc, which is capable of rotation, so that any one of the series of lenses may be brought before the aperture (Fig. 16). The ophthalmoscopic examination is made in a darkened room, the patient being placed in front and somewhat to the side of a single source of illumination. The examiner, stationing himself before the patient, with the central aperture in the mirror held close to his eye, collects the rays of light from the lamp upon the mirror of the ophthalmoscope and directs them upon the eye to be examined. The patient is then requested to direct his gaze directly in front of him, while the examiner, with relaxed accommodation, slowly approaches to within a few inches of the patient's eye, keeping the pupil steadily illuminated. To one versed in the art of ophthalmology, the interior of the eye is at once visible, and may be studied without inconvenience or strain to the patient or observer for a protracted interval. By means of the lenses which may be brought into the line of vision, it is possible to measure with considerable accuracy any errors of refraction present.

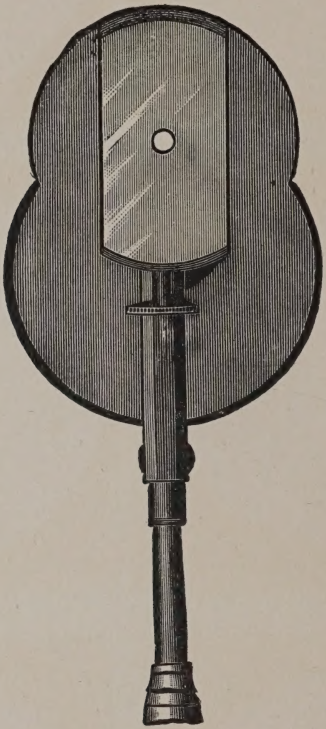
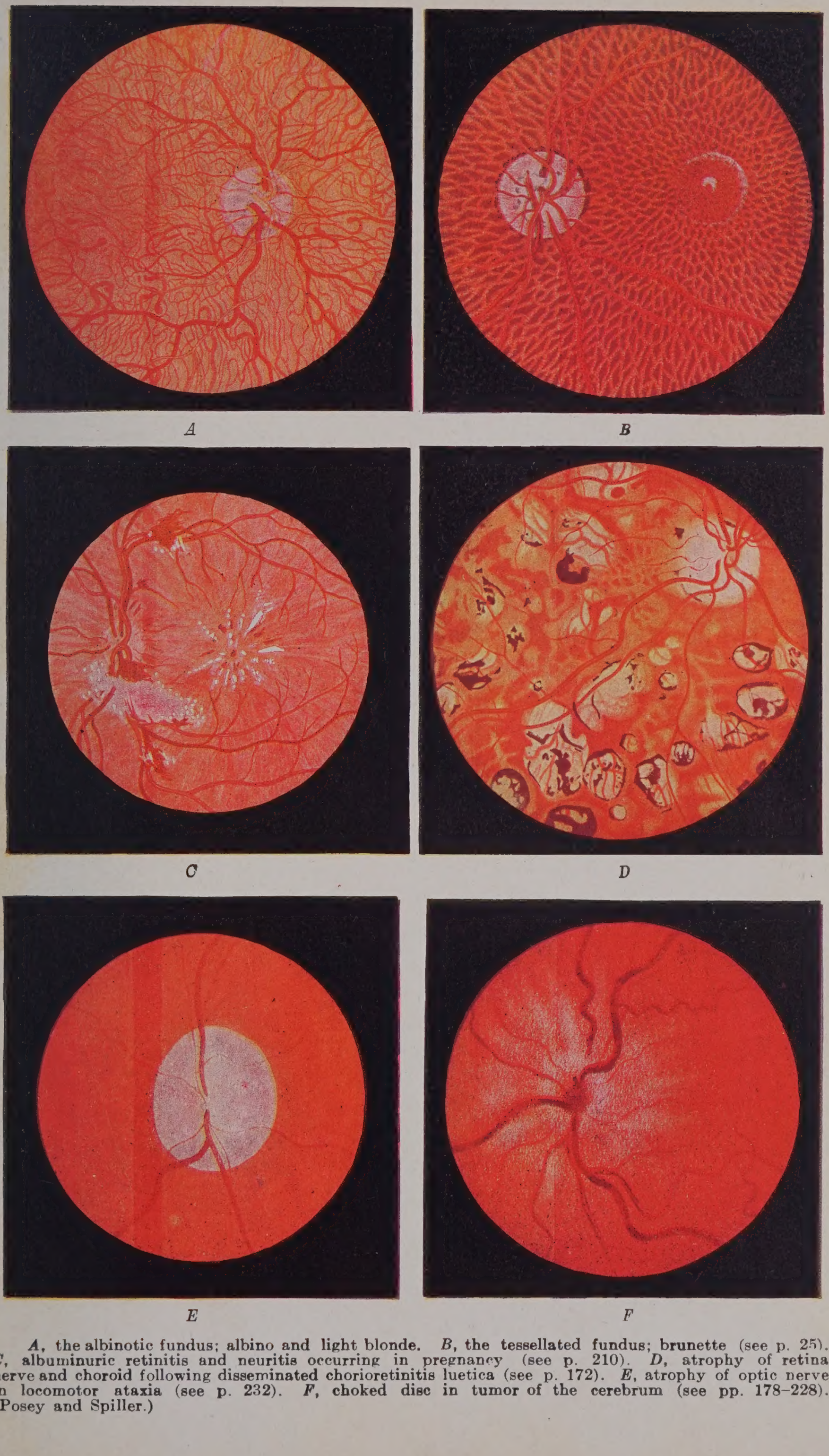


FIG. 16.—Loring's ophthalmoscope; front view. The perforated mirror in this case is cut into a quadrangular shape, so that it can be rotated slightly from side to side (tilting mirror). This is to make the reflection of light less oblique in using the direct method. The lower disc contains a series of lenses which can be rotated by the pressure of the finger on the serrated edge of the disc, so that any desired lens can be brought in front of the sight-hole. Usually there is added a quadrant on the back, containing additional lenses, which being superimposed over those in the revolving disc make a great variety of combinations.

PLATE II.



*A*, the albinotic fundus; albino and light blonde. *B*, the tessellated fundus; brunette (see p. 25). *C*, albuminuric retinitis and neuritis occurring in pregnancy (see p. 210). *D*, atrophy of retina nerve and choroid following disseminated chorioretinitis luetica (see p. 172). *E*, atrophy of optic nerve in locomotor ataxia (see p. 232). *F*, choked disc in tumor of the cerebrum (see pp. 178–228). (Posey and Spiller.)

Precise measurement of the refraction of the eye is accomplished by observing the direction in which the light appears to move across the pupil as the mirror held close to the observer's eye is rotated in the vertical and horizontal meridians. In the application of this test, which is termed *retinoscopy,* or the shadow test, the observer stations himself at a metre's distance from the patient, and superimposes lenses of various kinds and degrees before the patient's eye until the requisite change in direction of the movements of the light is attained. To insure accuracy, complete pupillary dilatation by the instillation of some drug to accomplish this purpose is necessary. When properly performed, this test is one of exceeding accuracy, and enables the examiner to ascertain not only the amount of far- and near-sightedness present, but also the axis and degree of the astigmatism.

The picture of the interior of the eye revealed by the ophthalmoscope is one of great beauty. Varying in shade, depending upon the amount of pigmentation, being lighter in blondes and darker in brunettes, the fundus presents a uniformly pinkish-yellow appearance, broken by the reddish walls of the retinal arteries and veins, as they course over the retina in their exit and entrance in the optic nerve. The head of this structure is plainly visible, and presents itself as a small pinkish-white plaque, surrounded by a fine layer of pigment, which defines its edges from the surrounding tissues. Not far from the outer side of the nerve is the macula lutea, the most highly sensitized of all the parts of the retina, as it is upon this point that the central rays of light are converged. This important area is darker than the rest of the fundus, with a small bright spot in the centre called the fovea centralis. The variations from this healthy or physiological appearance of the fundus will be discussed in future chapters (Plate II, *A* and *B*).

# CHAPTER III

## DEFECTS OR ANOMALIES OF REFRACTION AND THEIR CORRECTION

### SPECTACLES AND EYE-GLASSES

As we have already seen, by the refraction of the normal eye is meant the power the eye has of so acting upon the rays of light passing through the pupil that they are converged upon the retina. This is accomplished without effort or strain unless the power of the eye be taxed unduly. If, however, the build of the eye departs from the normal and its length is too short, as in the far-sighted eye, or too long, as in the near-sighted eye, clear vision is attained only by the exercise of strain or, as is the case in the near-sighted eye, by the aid of suitable glasses.

FAR-SIGHTEDNESS OR HYPERMETROPIA.—As may be seen by the diagram of a far-sighted eye (see Fig. 11), by reason of its deformity in length, entering parallel rays of light are not brought to a focus upon the retina, but unite some distance behind this membrane, this distance varying in amount with the length of the eye. Under such conditions clear vision is impossible. Happily, however, the eye is equipped with a mechanism which can readily correct this lack of refraction power and bring parallel rays of light to a shorter focus. This consists in increasing the refractive power of the crystalline lens by a spontaneous and voluntary contraction of the ciliary muscle. In the normal eye the ciliary muscle is relaxed in distant vision, coming into action only when the eye focusses on a near object. In hypermetropia, however, sharp vision both for far and near is only obtained through the aid of this important muscle, the degree of its contraction varying with the demand placed upon it, being greater the higher the degree of the far-sightedness and *vice versa.*

This constant and unnatural demand upon the ciliary muscle, however, after a time is associated with evil consequences. In the young and vigorous the strain may be maintained for a long time without perceptible disadvantage, but in older subjects and those with impaired health, symptoms of fatigue of the ciliary muscle soon manifest themselves. These may express themselves in a variety of ways. In the first place, vision is not always clear, and this is particularly true of near vision. As we have seen on page 18, the perception of near objects is accomplished by the act of accommodation, which consists in increasing the convexity of the crystalline lens by action of the ciliary muscle. Precisely the same mechanism is employed to overcome far-sightedness. When a far-sighted eye is called upon to accommodate for a near object, it has already expended some of its power in overcoming its deficiency in length, and has lost considerable of its reserve accommodative power. If the degree of far-sightedness is considerable, therefore, or if the ciliary muscle has been weakened by a general state of muscular weakness, or, what is more important, if the lens has become harder from age and requires greater muscular contractability to affect its curvature, the perception of the eye for small objects close at hand is much impaired, if not entirely lost. In moderate amount of far-sightedness, the strain on the ciliary muscles evidences itself by blurring of the type, for example, in reading, or a running-together of the stitches in sewing. In far-sightedness of high degree, even distant vision may be impaired, the ciliary muscles being unequal to the strain of maintaining a constantly increased curvature of the lens for a protracted period.

The activity of the ciliary muscle may also give rise to deleterious changes within the eye itself and the structures neighboring upon the globe. Continuous contraction of the ciliary muscle means an increase in the amount of blood within the muscle, to provide for its nourishment and maintenance. Contiguous structures, such as the choroid, retina, and optic nerve, also participate in this state of hyperæmia, as it is called, and mild inflammatory changes are evoked, which give rise to symptoms emanating from these tissues. Sensitiveness to light is complained of and the eyes become red and irritable; the conjunctiva and lids also sharing in the hyperæmia, become inflamed also.

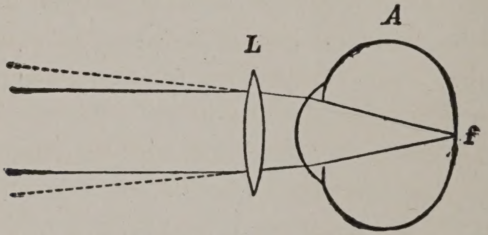


Fig. 17.—Correction of hypermetropia by a convex lens. The eye is drawn of the natural size of a hypermetropic eye having an axial length of 21 mm.

Muscular activity necessitates the expenditure of nervous force also, and in consequence of the maintenance of the ciliary muscles in a state of continuous action, constant impulses must be sent from the brain for their innervation. Headache is originated and a series of nervous reflexes, which will be treated of in a subsequent chapter. Owing to the strain placed upon the muscles rotating the eyeballs inward, far-sightedness of high degree frequently gives rise to strabismus or cross-eye (see p. 52).

The optical principles involved in the correction of far-sightedness are extremely simple, consisting merely in the determination of the far-sightedness, and the removal of the strain upon the ciliary muscles, by the superposition before the eye of a convex lens equal in amount with the refraction error (Fig. 17). This auxiliary lens at once removes the necessity for the increased curvature of the crystalline lens, and the ciliary muscle is again placed at rest, in so far at least as distant vision is concerned.

Although the optic principles involved are simple, the prescribing of glasses in far-sightedness is often a matter of some complexity. In the first place, the degree of far-sightedness is not always the same in all the meridians of the eye, and the complication of astigmatism may be present. Secondly, there is some dispute regarding the proper manner of determining the amount of hypermetropia present. Most cautious and thorough ophthalmologists claim that this can only be accomplished, in subjects under 40 years of age, by the local use of some drug which will suspend the action of the ciliary muscle. Others, chiefly opticians and optometrists, who are not permitted by law to employ any form of drugs in their examinations of the eye, assert that this is unnecessary and that accurately prescribed lenses may be given without putting the ciliary muscles at rest.

Were the eye but a camera, a fixed and stable optical apparatus, and the regulation of its focussing apparatus unassociated with muscle spasm, it would be a simple matter to determine the degree of far-sightedness present by ascertaining the strongest convex lens by means of which the sharpest degree of distant visual acuity was attained. After 40 years of age, the eye approaches in a manner the stability of such a fixed optical instrument, for, as we have seen, after that age the lens becomes so hard that the ciliary muscle has but little power to change its shape. In subjects over 40 years of age, therefore, satisfactory results may usually be attained in this manner. In younger persons, however, an active muscle, operating upon a flexible lens, has to be taken into consideration, as well as the deleterious effects which may have arisen in the eye in consequence of the vicious use of that muscle. It would be beyond the scope of this work to enter into a full discussion of all the optical principles involved in refraction, and to attempt an explanation of the various changes which occur in the ciliary muscle in errors of refraction. It may be stated, however, that in far-sightedness, in consequence of the extra work placed upon it, the ciliary muscle becomes excessively strong, and hypertrophies. Its contractions frequently become spasmodic and render all attempts to estimate the degree of the refraction error extremely difficult. Before the exact amount of far-sightedness present in any eye under 40 years of age can be accurately determined, therefore, some means must be used to eliminate the action of this muscle and to prevent its contractions modifying the results of the examination. Fortunately, such means are afforded by a class of drugs termed " mydriatics " or, better, " cycloplegics," drugs which have the power of dilating the pupil and temporarily suspending the power of the ciliary muscle.

These drugs are of two classes, the quick-acting, of which homatropin is the type, and atropine, a derivative of belladonna, whose effects are much more lasting. Generally speaking, atropine is the ideal drug for refraction purposes, for it not only assures a complete abeyance for a time of all action of the ciliary muscle, but it secures for the tissues of the eye a needful rest, which is often most essential after the eye tissues have been long subjected to the effects of strain. As we shall see in the description of near-sightedness, a large proportion of near-sighted eyes develop from uncorrected far-sighted eyes, whose tissues have been strained and softened by the unnatural strain placed upon them. In such eyes, the prolonged use of atropine is invaluable, the softening and stretching process being entirely arrested by it. In children, the coats of whose eyes are weak and yielding and whose ciliary muscles are strong and active, atropine is the drug of choice.

The objections to atropine are the length of time necessary to complete the test, the effects of the drug lasting for about ten days to two weeks, and the constitutional symptoms which appear at times after even one instillation of the drops. The first objection is readily met by a consideration of the advantages to be derived from this short interruption of work or pleasure. Unless the condition of the eyes to be refracted shows signs of urgency, the refraction test under atropine, in the case of school children, can usually be postponed until the holidays, and in other cases few employers will grudge an employee sufficient time to gain a greater efficiency in his work by obtaining proper ocular treatment.

The constitutional symptoms which occasionally appear, though made much of by optometrists and others who are prevented by law from employing drugs of any kind in their refraction work, are usually very slight, and pass away rapidly after the cessation of the treatment. A diminished dosage in children and refraining from the use of atropine in extremely warm weather are usually the only safeguards necessary to be observed. Another objection is sometimes made that atropine may precipitate an attack of glaucoma. In elderly persons predisposed to glaucoma, such accidents have been known to occur, but may easily be prevented by the careful systematic examination of the eyes which should precede the instillation of drugs of any kind for refraction or other purposes. Most eye surgeons of experience have treated thousands of cases without having this unfortunate accident happen.

Near-sightedness, Myopia.—Diametrically opposite to the far-sighted eye is the near-sighted or myopic eye, for in this anomaly of refraction the eyeball is too long, and rays of light coming from a distance are brought to a focus in front of the retina. We have seen how the far-sighted eye may secure clear distant vision by a contraction of the ciliary muscle, but in myopia such an increase in the focussing power of the eye only accentuates the difficulty, nor is there any other mechanism possessed by the near-sighted eye which enables it to overcome its visual deficiency, so that the myope is dependent entirely upon the artificial aid of lenses to see distant objects clearly. By squinting the lids, and excluding some of the marginal rays entering the eye, the myope is enabled to see somewhat clearer, but the degree of visual clearness obtained by this means is very slight.

As has been stated in an earlier chapter, the shape of the skull frequently determines the conformation of the orbit, which, in its turn, moulds the form of the eyeball. Myopia, therefore, occurs most commonly in races like the Teutonic, whose skulls are long in the anteroposterior diameter, and is but rarely met with in the negro and Indian, where the converse is the rule.

Owing probably to the transmission of the shape of the skull favoring the development of myopia, this error of refraction is often hereditary, being transmitted through several generations and often occurring among many members of the same family. Myopia is but rarely congenital, generally developing from the eighth to the tenth year, its appearance at that time in eyes formerly emmetropic or far-sighted being traceable to (*a*) the hereditary influence just referred to, (*b*) unusual strain upon the eyes, either from overuse or use under improper conditions of lighting, etc., (*c*) ill health, or (*d*) to some irregularity in the corneal curvature, or haze of the refracting surface of the eyes, which impairs, though but slightly, the proper focussing of the rays of light upon the retina.

As we have seen, the myopic eye is too long an eye. Emmetropic and hypermetropic eyes become myopic in consequence of a stretching in their coats, a process which is never physiological and is accompanied by more or less danger to the ocular structures. Myopia exhibits also a marked tendency to be progressive, the degree of the nearsightedness tending to increase year by year until the process is arrested. This arrest in the stretching process usually happens in healthy subjects whose eyes are not subject to too great strain, between the ages of 20 and 30 years, but in some cases it continues through life, and, being always attended with evil consequences to the integrity of the eyeball, may cause such damage that the eye no longer is possessed of useful vision. Indeed, in some cases the damage suffered is so great that the removal of the eye is necessitated for the relief of pain and other inflammatory symptoms. To show the effect of school life upon the eyes the following percentages of Cohn, a German ophthalmologist, who made extensive researches some 50 years ago, with a view to determining the incidence of myopia in Germany, are of interest:

| | Percentage of myopia |
|---|---|
| Five village schools | 1.4 |
| Twenty elementary schools | 6.7 |
| Two higher girls' schools | 7.7 |
| Two intermediate schools | 10.3 |
| Two *real-schulen* | 19.7 |
| Two gymnasiums | 26.2 |

Among the students of the university, Cohn found the percentage of myopic eyes had advanced to 59.5. His conclusions demonstrated that not only does the number of short-sighted pupils increase from the lowest to the highest schools, but that the increase is in direct proportion to the length of time devoted to the strain of school life. In 1885, Risley and Randall compiled a similar group of statistics based upon the examination of a large number of eyes by competent American oculists, and found an analogous, though somewhat lower continuous progression in the percentage of myopia in American schools. In 1907, the author, in conjunction with Dr. R. Tait McKenzie, Director of the Department, in his capacity as Ophthalmologist to the Department of Physical Education in the University of Pennsylvania, made an analytical study of the eyes of 883 students in the various departments of that institution. In the comparison which was made to ascertain the influence of age and study on the refraction, it was found that among 633 students in the two lower classes, 87.25 per cent. were hypermetropic and 12.75 per cent. were myopic, while of 261 students in the upper classes, 80.25 per cent. were hypermetropic and 19.75 per cent.

were myopic. The average of all the scholars examined was 21.4 years, and the statistics showed an increase of about 2.5 per cent. of myopia for each year during the four years of college life. Five per cent. more of myopia was found in the professional departments in scholars of a similar age than in the college department, this being doubtless accounted for by the fact that most of the scholars in the college come from private or city schools, where the eyes are properly protected, while the scholars in the professional schools come from rural communities, where accurate refraction is impossible and the care of the eyes neglected.

In addition to the professional classes, many artisans whose work entails prolonged and taxing eye work become myopic. Hebrews, owing perhaps to racial peculiarities of skull, are often near-sighted, frequently to the highest degree.

On account of their poor vision, myopes without glasses are greatly handicapped in many ways. Thus individuals with this build of eyes often manifest a strong distaste for all outdoor sports in which sharp vision is a requisite, and acquire a marked predilection for indoor occupations, painting, books, etc., a taste which is especially unfortunate, as prolonged near work of all kinds only aggravates their difficulty and adds to their ocular deficiency. In consequence of their inability to note the expression of those with whom they come in contact, the myope often develops an abstracted and even a stupid expression of countenance, and exhibits a degree of shyness not so frequently seen in those with normal vision. Although there may be but slight strain placed upon their ciliary muscles, uncorrected near-sightedness frequently gives rise to headaches and the other symptoms enumerated elsewhere as the consequence of eye-strain.

The diagnosis of near-sightedness, when present to an appreciable degree, may be suspected, when in addition to poor distant vision the subject is able to read the finest type with the greatest ease, provided the book or magazine is brought close enough to the eyes (Fig. 18).

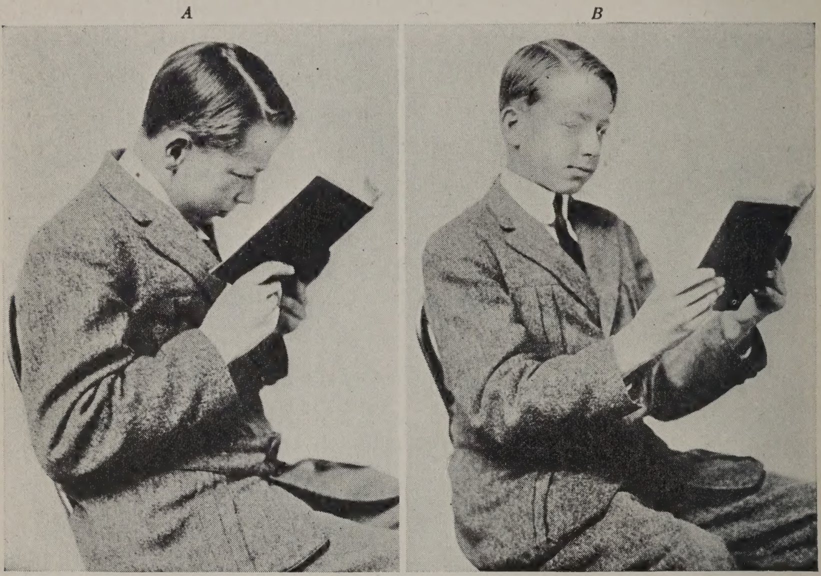


Fig. 18*A*.—This near-sighted boy is trying to read without glasses and is in danger of serious trouble later if neglected. Properly fitted glasses would add to the boy's comfort and appearance, as well as provide insurance for his future.

Fig. 18*B*.—When glasses are properly fitted, comfort and safety are secured.

Upon ophthalmoscopic examination, the observer will note certain characteristic changes in the fundus dependent in degree and extent to the amount of stretching which the eye has undergone. Most constant of these is a crescentric area of partial and complete atrophy of the choroidal and retinal elements to the outer side of the optic nerve, which in high grades of myopia may extend to and even involve the area of most distinct vision.

By reason of the lessened demand upon accommodation, correlated convergent efforts are also diminished and myopic eyes frequently become divergent.

The eyeball being elongated unduly, the vitreous is no longer adequate to fill the space it occupies under normal conditions, and becoming disorganized by the attendant choroidal disease, becomes fluid and more or less filled with opacities, which float to and fro with the movements of the eyes and occasion the motes or *muscæ volitantes,* which become a source of great annoyance. Finally, as a result of the lack of support given it by the altered vitreous and weakened by the sublying choroidal disease, the retina, in response to some slight tap upon the eye or to some jar of the body, floats loose from its attachments and encroaches upon the space normally occupied by the vitreous. Loss of sight in the area occupied by the detachment follows, and unless reparative measures be properly applied, and unfortunately in many cases, even in spite of the most prompt and best medical care, total blindness may ensue.

From the foregoing it must be evident that myopia is a pathological condition of the eyes which demands the most careful consideration, not only of the oculist but the layman as well. There is a more or less general impression that near-sighted eyes are stronger than others, and on account of ease in reading, etc., myopes not infrequently transgress the laws of prudence and prolong the use of the eyes at close work beyond reason. Often it would appear as though the tax was without deleterious consequences, and the eyes apparently tolerate years of abuse without giving signs of failing. By middle life, however, the changes wrought by misuse rarely fail to manifest themselves, and the unfortunates who have persisted in the maltreatment of their eyes are now forced to be sparing of their use, at a time when physical limitations curtail the enjoyment of participation in an active outdoor life and necessitate sedentary habits. The prevention and correction of myopia, therefore, is a problem of great sociological as well as medical significance, and it must be a matter of gratification to their countrymen that American oculists for many years have devoted much study and effort to its solution.

The prevention of myopia includes a steadfast and intelligent observance of all the details enumerated in Chapter VI, but especial emphasis must be laid upon the necessity for an early examination of all children's eyes, with a view to ascertaining the state of the refraction, and for the prompt and efficient correction of any errors which may be found. The laity must disabuse its mind that the wearing of glasses has any weakening effect upon the eyes, and must appreciate that the most potent factor to prevent the progress of ocular deficiencies is properly adjusted glasses. One of the most pathetic, and unfortunately a not uncommon experience of the oculist, is to have children with eyes well advanced in myopia brought for consultation by parents who have deferred the visit in the hope that the longer they postponed the examination, the more chance there will be of the apparent error of diminished distant vision being outgrown. Errors of refraction are never outgrown, but, on the contrary, if they are permitted to go uncorrected, steadily increase, often insidiously, with remarkable rapidity.

Parallel rays of light falling upon the cornea of a near-sighted eye are brought to a focus in front of the retina. Myopia is corrected, therefore, by the superposition of a concave lens before the eye, such lenses having the property of causing the divergence of rays of light passing through them, and the weakest concave glass which enables the near-sighted eye to see sharpest is the measure of the degree of myopia present (Fig. 19).

Other important factors, however, must be taken into consideration before finally determining the lens which shall be prescribed, for, as in hypermetropia, the selection of the correcting glasses demands considerable skill and judgment. Astigmatism may be present, and, as in hypermetropia, there may be more or less associated spasm of the ciliary muscle, which may mask the true amount of myopia present by adding to it, in consequence of the increased thickness of the lens, and the earlier refraction of the rays which is thereby occasioned. The necessity for the employment of a cycloplegic in the measurement of myopic eyes is of even greater importance, therefore, than in testing far-sighted eyes, for if too strong concave glasses are prescribed, the ciliary muscle will be excited to still greater action, and, thereby increasing the intra-ocular congestion and softening the coats of the eye, cause actual increase in the myopia. Atropine, therefore, should be the drug of

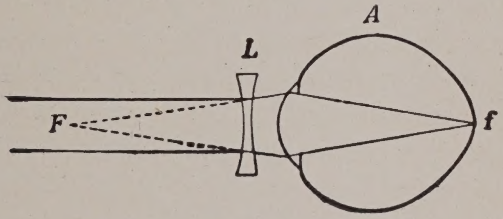


Fig. 19.—Correction of myopia by a concave lens. The eye is drawn of the natural size of a myopic eye having an axial length of 27 mm.

choice in all tests of myopic eyes in childhood and adolescence, the drug having the two-fold advantage of not only enabling the examiner to determine with accuracy the degree of myopia present, but also of putting the coats of the eye at rest, of diminishing the congestion of the eye, and allowing the eyeball to recover its natural vigor and tone. Instead of " drops," so-called, being harmful, in this class of cases they are, on the contrary, actually priceless, and often check the progress of a rapidly increasing nearsightedness.

As the tendency of myopia is to increase, examinations should be made annually, until a period of comparative non-progressiveness has been reached. After that, examinations every two or three years are ordinarily sufficient.

While under certain conditions in older subjects correcting glasses need be worn only to secure sharp distant vision, in myopic children and adolescents it is imperative that they be worn constantly, to remove all strain in near as well as in distant use of the eyes. As must be apparent from what has already been said about the progressive nature of myopia and the yielding tissues of the child's eye, no prejudice about the wearing of glasses by children for cosmetic or other reasons should be permitted to outweigh the great benefit to be derived from this most potent and accurate manner of relieving ocular strain. After the period of adolescence has passed and the danger of the myopia increasing is lessened, it is oftentimes feasible, provided the degree of the myopia is not too great, and the coats of the eye healthy, to remove the glasses for constant use and to resort to them only at close work, or at such times at it may be desirable to obtain full distant vision. Ordinarily the same lenses may be worn for both far and near use; in certain cases, however, it is desirable to prescribe a weaker pair of lenses for close work. If the near-sightedness is attended with marked weakness of the ocular muscles, prisms are often of value, and may be ground into the concave lenses correcting the myopia. In some cases, division of one or more of the eye muscles is desirable. Myopia of very high degree is sometimes lessened by the removal of the crystalline lens by operation. This procedure, however, is not without danger, and is only to be recommended in extreme cases.

As myopia increases with the use of the eyes, parents and those engaged in the education of the young should realize the dangers of excessive reading and the prolonged use of the eyes in all kinds of fine near work. In Chapter VI detailed instruction regarding this and other phases of the care of the eyes will be given in full, as well as an account of the method which has been suggested for the education of high myopes.

As near-sighted individuals can at all times, unless there be considerable astigmatism present, see near objects clearly, they possess the advantage over those who are emmetropic or hypermetropic of being able to read, etc., in advanced life, after the presbyopic period has arrived, without glasses. It is for this reason that the impression has spread that near-sighted eyes grow stronger and vision improves with age. This is not true, however, as the degree of true myopia never lessens, and proper concave glasses must be worn at all times to obtain clear distant vision.

The so-called "second sight," or ability acquired by some individuals to read late in life without the aid of glasses, is really symptomatic of cataract, and is due to swelling and increase in the refractive power of the lens, which is one of the stages of this form of ocular disease.

Astigmatism.—As has been defined elsewhere, astigmatism is an error of refraction, dependent not upon the shape of the entire eyeball, but upon an irregularity in curvature in one of its refracting surfaces, usually the cornea. If the curvatures of the two principal meridians of the cornea are at right angles to one another, the astigmatism present is said to be regular; irregular when the unequal curvatures bear no definite relation to each other. The latter form of astigmatism arises usually from injury or disease of the cornea, which has affected its transparency as well as its refracting curvatures. Irregularities in the structure of the lens produce a slight amount of this form of astigmatism in all eyes, which accounts for the irradiation about the stars and for the rays of light which shoot out from street lamps and other distant points of light. In regular astigmatism, if the inequalities between the two meridians of the cornea be but slight, vision may be but little interfered with, but if the degree be at all marked, the foci of the two sets of rays are so far apart that only a blurred image of surrounding objects is obtained. Astigmatism may be either hypermetropic or myopic, according as one meridian is more or less curved than the other meridian; mixed when one meridian is myopic and the other hypermetropic; or compound, when both have different degrees of myopia or hypermetropia. A popular demonstration of astigmatism is to draw a line around an egg through the ends and another around the middle, at right angles to the first; it will be evident that these lines have a very different curvature, and that if the egg were made of glass it could not form a sharp focus, as a glass sphere does—it would be astigmatic.

The symptoms evoked by astigmatism, in consequence of the strain placed upon the ciliary muscle in its efforts to focus the rays of different lengths, are usually very pronounced, and this form of ametropia may be suspected when, in reading, the letters are confused and seem to run together (Fig. 20), and when the head is inclined to one

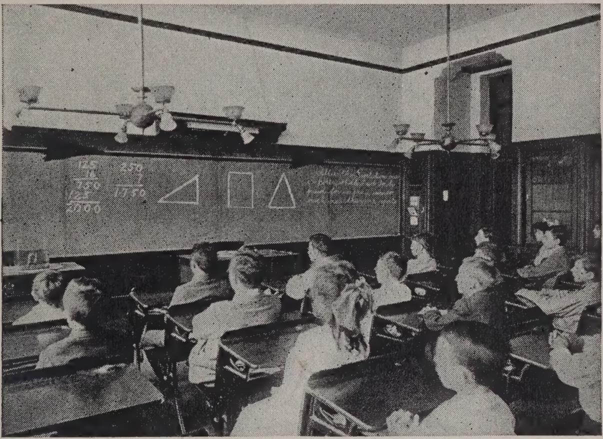


FIG. 20*A*.—Figures on blackboard sharp and clear. This is the way they look to the child with abnormal eyes after he has been properly fitted with glasses.

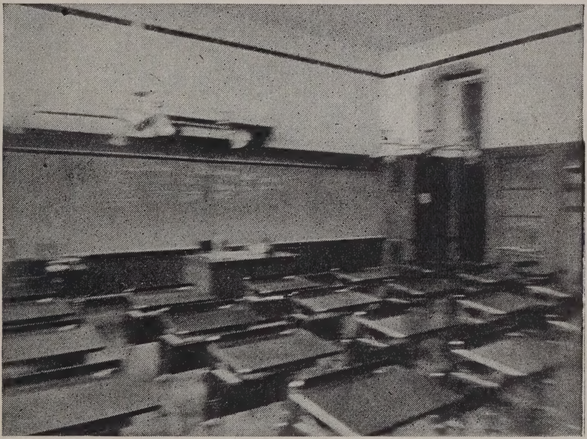


FIG. 20*B*.—Blurred picture of schoolroom, showing how room looks to a child with astigmatic eyes.

side in an effort to obtain sharper vision. The lids are frequently contracted in an effort to shut out marginal rays. Headache is common and other forms of reflex nervous disturbances are present. If an astigmatic person close one eye and gaze fixedly at a so-called astigmatic dial (Fig. 21) placed 5 metres from the eyes, he will note that certain rays appear much darker and more distinct than others. This device often enables the ophthalmologist to determine the axis of the corneal curvature, and is of service in the final prescription for glasses. Astigmatic persons usually attribute their poor vision to near-sightedness. No form of spherical surface, be it convex or concave, will, however, improve vision, for what is needed in simple astigmatism is a glass which will correct one meridian without affecting the other, and in compound or mixed astigmatism, a glass with two curved surfaces, one adapted to each meridian. A section of a cylindrical glass supplies the want. Fig. 22 represents such a glass; the rays of light *ab* passing through its axis, meet with no curve and are unrefracted, while those at right angles *cd* meet with a strong convex surface and are brought to a focus. Such cylindrical lenses are cut in the form ordinarily used in glasses and placed in the direction corresponding to the curvature of the astigmatism. They may also be

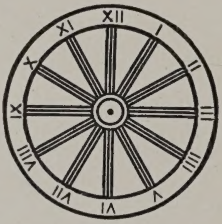


FIG. 21.—Astigmatic dial.

incorporated with spherical lenses in the correction of cases of compound astigmatism, *i.e.*, astigmatism associated with far- or near-sightedness.

The correction of astigmatism calls for the same care as has already been outlined in the discussion of the treatment of far- and near-sightedness. In subjects under 40 years of age, some form of cycloplegic is absolutely essential to determine the amount and axis of the astigmatism, for the compensatory action of the ciliary muscle often obscures the amount of the astigmatism and shifts its axis. A faulty correction of astigmatism is almost as harmful as no correction, and no glasses should be prescribed until the examiner has been satisfied, by several examinations in which he has been aided by the various tests which have been devised by ophthalmologists for the detection of this error of refraction, that he has determined with absolute accuracy both its amount and axis.

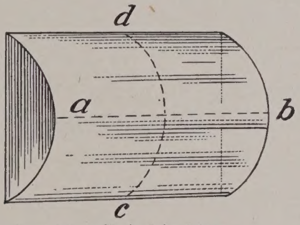


Fig. 22.—Cylindrical lens.

Antimetropia; Anisometropia.—These terms are used synonymously to define different degrees of refraction in the eyes of the same individual. Thus one eye may be near-sighted and the other far-sighted or astigmatic, and often considerable degrees of muscular imbalance accompany the condition, with attendant difficulty in obtaining comfortable simultaneous use of the two eyes. If one eye is very near-sighted and the other almost of normal build, it is at times desirable not to attempt the correction of the myopic eye, and refract one eye only.

PRESBYOPIA.—When considering the subject of accommodation, presbyopia was defined as the loss in the power of accommodation due to advancing years, and was found to be dependent upon an increasing hardness in the crystalline lens. This hardening process is entirely physiological and there is nothing abnormal for one who has previously suffered from no ocular limitations whatsoever to be compelled to resort to glasses to see small near objects clearly at some time between the ages of 40 and 50 years. The elongation of the eye by myopia and the added refraction strength acquired in this way may postpone the necessity of the near-sighted wearing glasses to correct presbyopia until several years beyond the normal period, and if the degree of the myopia be considerable, persons with this error of refraction may be able to read the finest type without glasses throughout life—a slight advantage to counterbalance the limitations of far-sight always possessed by myopes. On the other hand, hypermetropia, by the additional strain it entails upon the muscles of accommodation, precipitates presbyopia. If, in the years preceding the advent of the period at which presbyopia usually manifests itself, the eyes have been of normal build and there is no astigmatism present, the prescribing of lenses to improve the perception of near objects is a simple matter and may in many instances be left in safety to the optician and optometrist, always with the recognition, however, that in so doing the opportunity of submitting the eyes to a thorough examination with a view to determining possible disease of the eyes or general system is not taken advantage of, as would be the case were the test made at the hands of a competent medical adviser. If astigmatism or other associated anomaly of refraction is present, or imbalance of the ocular muscles, the test becomes more complicated and an expert examination is essential. Uncorrected presbyopia calls for a convex spherical glass for its correction, thereby supplementing the refractive power lost by the rigidity of the crystalline lens. The strength of the lens must be increased every year or two, to supplement the increasing hardness of the lens, until the age of 55 or 60 years has been reached, after which time no increase in the lens strength for purely presbyopic purposes is necessary, although later swelling in the lens from cataractous change, or from certain structural changes in the eye, may necessitate additional tests and other lenses.

### Spectacles and Eye-glasses

Correcting glasses may be worn either in the form of eye-glasses or spectacles. Monocles, or single eye-glasses, so popular among the military and others of the upper classes abroad, have fortunately never been popular in our own country, as they throw undue strain upon the eye in use and can only be regarded as a makeshift and never as a lens capable of correcting a refraction error.

In the event that lenses must be worn constantly, spectacles will under nearly all circumstances be found more useful than eye-glasses. Cosmetically, however, the latter are to be preferred, and unless there is some structural peculiarity of the nose which prevents the proper adjustment of eye-glasses, or unusually heavy lenses, or lenses containing cylinders for the correction of astigmatism of such high degree that the slightest deviation in their axis is attended with distress, adults may safely wear this form of adjustment. On account of the liability to displacement and accident in play or romping, children should always be fitted with spectacles and these should be provided with stout rims for additional strength and to prevent injury to the eye from the shattering of the lenses in case of accident.

The choice between spectacles and eye-glasses is, however, so far as adults are concerned, of but minor importance in comparison with the adjustment of the lenses before the eyes. The average person considers that the oculist has finished his work when after the test he has been given the formula and has obtained the glasses from the optician. Every oculist, however, who is at all alive to the welfare of his patients and his own reputation will insist that he be given an opportunity to ascertain that the lenses have been ground according to his prescription and to see the lenses which he has prescribed in position before the eyes. Many a carefully selected formula has failed to give the relief expected by reason of a careless adjustment. Not only must the centres of the lenses correspond to the ocular centres, but the distance of the lenses from the eyes must be proper and no greater space permitted between the two than is sufficient to prevent the tips of the eyelashes from touching the glass.

Lenses must be worn at a correct angle, *i.e.,* somewhat slanting, so that the top of the lenses is somewhat farther away from the eyes than the lower portion. The accompanying photographs with their legends illustrate how glasses should and should not be worn (Fig. 23).

When lenses of different strength must be worn for far and near use, they may often be combined in bifocal form; that is to say, a reading segment may be fitted into a space cut from the lower half of the distance lens to admit

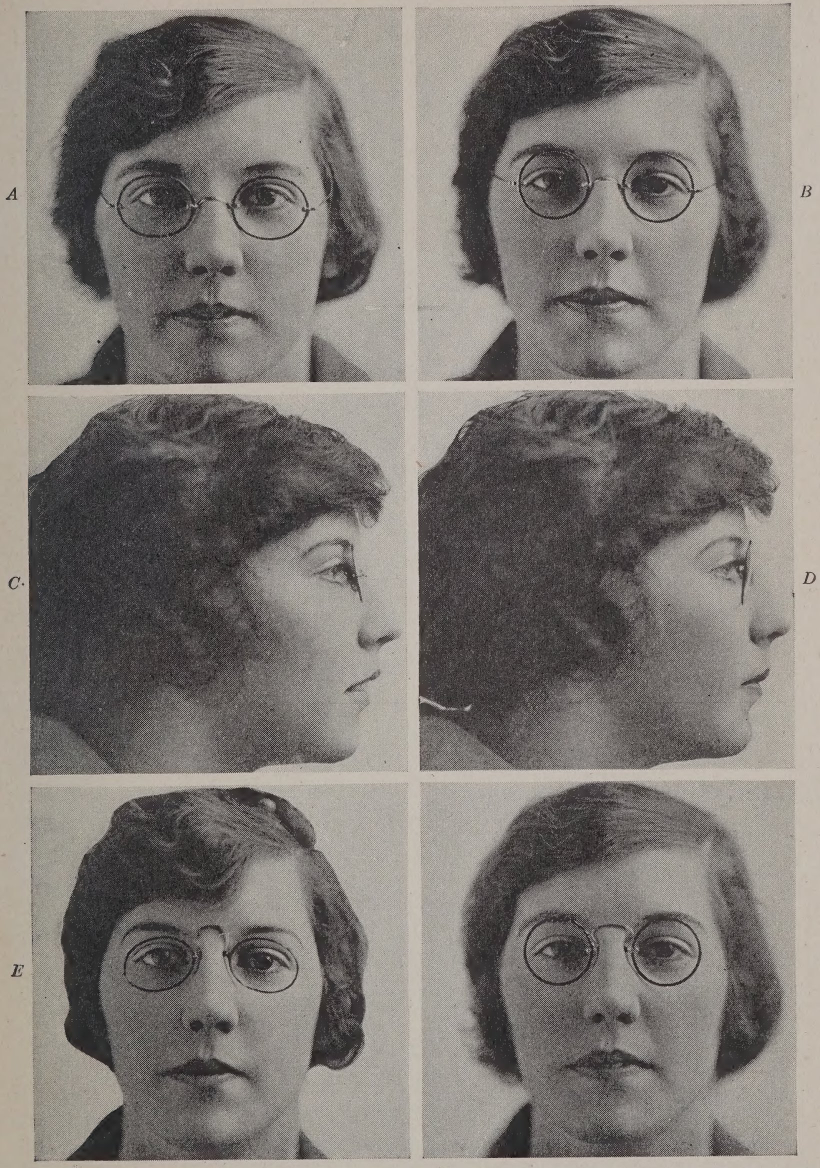


Fig. 23.—*A*, lenses too low and wide; *B*, lenses correctly positioned; *C*, lenses incorrectly inclined; *D*, lenses correctly inclined; *E*, lenses out of horizontal alignment; *F*, lenses correctly positioned.

it. Recent optical improvements permit of the reading glass being separately ground as an insert on the distance lens, or cemented or fused to it. This latter is known as the Kryptok lens, and the reading portion is invisible unless examined under certain aspects. While a great convenience, especially to elderly people, in obviating a change of glasses when adjusting the eye for various distances, many have difficulty in accustoming themselves to them, especially in walking, on account of the blur thrown over objects directly in front of the feet. A precise adjustment of the lenses, however, and some practice will usually overcome this slight disadvantage.

As a substitute for the bifocal, so-called " fronts " are sometimes prescribed, *i.e.,* the necessary strength of lens for reading is mounted in a rigid eye-glass or spectacle frame provided with hooks at each end, and slipped over the distance correction at will. Ladies frequently have lenses with proper reading strength mounted in a lorgnette, which they hold superposed over their distance correction.

When glasses are worn for near use alone, the lenses should be inclined forward and set about 5 mm. lower than those for distance, to conform with the usual downward fixation of the eye at close work. At times it is convenient to cut away the upper half of the reading glasses, so that the eyes obtain a clear view of distant objects over the top. As few eyes are not benefitted by a correcting glass for distance, the ordinary bifocal form is to be preferred.

Lenses should be amply large, though the present mode of extraordinarily large glasses is not to be commended, except for their employment in shooting, billiards, etc.

It is frequently of advantage to have the surface of the lens curved instead of being flat, the advantage of these periscopic or toric lenses being that the curvature of the glass approximately corresponds to the curve of rotation of the movements of the eyeball, and the refraction is the same through all parts of the lens, whereas in a flat lens, and especially those of high power, the eye sees clearly only through the optical centre of the lens, necessitating a turning of the wearer's head in observing all side objects.

Wearers of glasses should make it a point to visit the optician from whom they obtain their lenses at regular intervals, in order to rectify any errors in adjustment. Such service is usually rendered gratis and insures that the lenses are properly centred.

In recent years the prescribing of *colored or tinted glasses* has had quite a vogue, such lenses being ordered with the idea of preventing certain harmful light rays from entering the eye. There can be no question, however, but that this has been overdone and that neither daylight nor ordinary sources of artificial light contain radiations either in kind or degree which are injurious to the healthy eye. The comfort derived from amethyst, amber, and other tinted glasses is usually psychic and is imparted largely by the suggestion of the oculist or optician prescribing them. While healthy eyes under ordinary conditions require no interference with the rays coming from ordinary light sources, diseased eyes do. Under such circumstances, those of neutral shade, *i.e.,* those known technically as London Smoke, are to be preferred. Such lenses merely diminish the amount of light entering the eye without interfering with spectral or heat rays. The proper kinds of lenses to protect the eyes from the deleterious action of an excessive amount of light and heat rays has been discussed elsewhere.

# CHAPTER IV

## STRABISMUS, CROSS-EYE OR SQUINT

If for any reason the harmonious action of the muscles moving the eyes is disturbed, the normal parallelism of the axes is interfered with and the eyes become crossed. This may occur either as a result of paralysis of one or more of the eye muscles from injury or serious systemic disease; it may originate, as we have seen, from anomalies of refraction, or it may be congenital, and the eyes crossed from birth. The character of the strabismus may be simple or mixed. That is to say, an eye may turn in or out, in relation with its fellow, or this lateral deviation may be conjoined with a vertical one, depending upon the number of eye muscles affected. In paralytic squint, the deviation as a rule occurs more or less suddenly and double vision obtains. In strabismus from high degrees of farsightedness or from myopia, the development of the deformity is gradual and the perception of the image of the deviating eye is suppressed, and double vision is absent. It is also rarely present in congenital squint.

Squint or Cross-eye Resulting from Errors of Refraction.—Under normal conditions, both eyes are directed upon the same point at the same time. In regarding near objects, both eyes are strongly converged and held in this position of focus largely through the action of the internal rectus muscles, the two muscles chiefly concerned in rotating the eyes inward. Simultaneously with this strong convergent effort, to obtain a clear image of the object at which the eyes are directed, there must be a strong contraction of the ciliary muscle of each eye (Fig. 24). In eyes of normal build, this action between convergence and accommodation is equably adjusted and the balance is maintained without strain, but in high degrees of far-sightedness, the harmonious action is disturbed by the superadded amount of activity required by the ciliary muscles, necessitated by the shortness of the globes. The centres in the brain controlling accommodative effort must send additional stimuli to the ciliary muscles, and the correlated centres of convergence similar impulses to the convergence muscles. In consequence the eyes are converged out of proportion to the impulse needed for the distance upon which they are focussed. Binocular vision is maintained therefore only at the expense of great muscular strain and is relinquished if any condition arises which increases the difficulty or facilitates its interruption. Poor vision in one

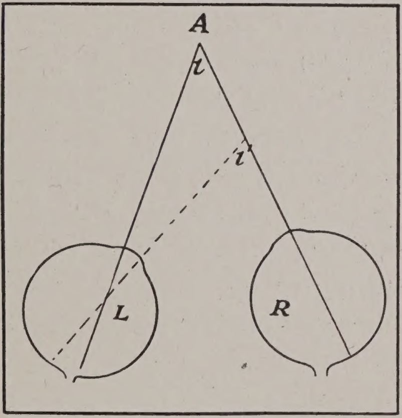


Fig. 24.—Showing an increase in the angle of convergence of the optic axis in consequence of an extreme rotation of one eye, *L*, inward. The angle *i'* is thus made larger than the angle *i*, obtained for the eye, *R*, which consequently received a clearer image of vision, object *A*, on its retina (Swanzy).

eye, either from astigmatism or disease, is an example of the former contingency and the accidental discovery by the subject that fixation with one eye while the other is temporarily thrown out of focus relieves the strain, typifies the latter. There are those who believe also that preternaturally weak brain centres controlling the muscles of the eyes is also a controlling if not the chief factor in the causation of squint.

In consequence of the causes just related convergent strabismus or cross-eye usually develops in hypermetropic eyes at about the third year, at the age when near objects are seriously regarded and the child holds the eyes in convergence when playing with toys, or regarding picture books, etc. The appearance of the squint soon after illnesses of various kinds frequently occasions the assumption that the particular disease from which the child has suffered has determined the ocular deviation. This idea, however, is erroneous, such illnesses precipitating the squint only in so far as they occasion a lowering of the general vitality and weaken the tone of the ocular muscles and the centres which supply them.

The correction of convergent squint consists in the establishment of a normal relationship between convergence and accommodation. This is accomplished by the adjustment of spectacles containing convex spherical lenses of sufficient strength to correct the amount of far-sightedness present. If this be done shortly after the squint has manifested itself, its correction is immediate and the eyes are straight as long as the glasses are worn. If there be delay and the lenses are prescribed some months or years after the strabismus has appeared, the squint may still persist, and the cure of the condition by glasses alone be impossible.

The reason for this is two-fold. In the first place, in consequence of the long suppression of the mental images received from the squinting eye, a happy device of nature to avoid the double vision which would naturally follow the departure from parallelism of the visual axes, the vision in the squinting eye becomes progressively impaired, and even though the refraction error be corrected by proper glasses, the eye will not coöperate with its fellow unless something is done to break up the habit of non-participation which it has acquired through disuse. Again, various contractions of the muscles occur, in consequence of faulty action, which prevent their properly coöperating with the muscles of the other eye, even after the normal balance between convergence and accommodation has been restored.

Squint, therefore, not only disfigures, but actually disables, impairing the vision of the crossed eye. Too much emphasis cannot be laid, therefore, upon the importance of correcting squint early. There is an impression, confined not merely to the laity but shared also by many general practitioners as well, that squint is often outgrown and that it is well to wait until the child suffering with squint is more matured before its correction is attempted. While this is sometimes true of the purposeless movements which are observed in the eyes during the first year of life, any constant deviation which persists after this age should awaken suspicion and should lead to the consultation of a competent oculist. While it may seem an unnecessary disfigurement to adjust spectacles to the eyes of a child two or three years of age, such action not only may insure straight eyes for life, but, what perhaps is more essential, may prevent the loss of sight in the deviating eye.

In some cases, glasses need not be given at such an early age, but the knowledge possessed by eye specialists should be spread wide that if efforts are not made to correct such eyes and develop the vision in the squinting eye before 6 years of age, but little can be done to restore sight in the deviating eye, even though the eyes be straightened by glasses or operative procedures. Ophthalmologists have at their command various instruments, based upon stereoscopic principles, to develop vision in this class of cases, which are often of great service, in conjunction with the correction of the refraction errors, in reëstablishing parallelism of the visual axes.

While in far-sightedness there is an associated excess of convergence, in near-sightedness there is a deficiency, the near-sighted eye, in consequence of its adaption for the perception of near objects, being enabled to regard these without the accommodative effort necessary to a normal eye. Too slight associated impulses, therefore, are sent to the converging centres, and near-sighted eyes show a strong predilection to deviate outwards, to become what is popularly known as " wall-eyed." Fortunately, in divergent squint, there is not the same tendency to suppression of the visual image as has been noted in the convergent variety, for the eyes, though failing to converge in harmony, maintain their vision independent of one another. The early prescribing of the proper concave spherical lenses is indicated in this class of cases, conjoined with the building up of the adducting strength of the weakened muscles by proper exercises with prisms, etc.

CONGENITAL SQUINT.—Not all cases of squint are dependent upon errors of refraction, for in many instances the strabismus is present at birth. In this type of strabismus, the muscles themselves are usually at fault, being faultily inserted into the globe, or, as sometimes happens, absent altogether. The degree of squint may vary in such cases from a slight deviation which is only manifest in certain excursions of the eyes, to an extreme deformity. As in divergent squint, vision may not be compromised, as both eyes frequently participate in binocular vision in some parts of the field of fixation. The need of early correction is not so pressing, therefore, as in convergent squint. Nevertheless, prompt detection of this variety of squint is of great importance, in order that proper measures may be instituted to insure parallelism of the visual axes as soon as possible.

Slight deviations, as in other varieties of insufficiencies of the muscles, may be corrected by means of prisms.

To gain parallelism of the visual axes, however, and to insure the participation of both eyes in all their excursions, some form of operative treatment is usually necessary. As in the treatment of the other varieties of squint, the operator has the choice of either weakening the muscles that are too strong by tenotomy, an operation which consists in partially or wholly loosening the tendinous attachment of the muscle into the globe, or of strengthening the weak muscles by a shortening process. These latter procedures are designated as advancements, and consist either in shortening the muscle by a process of " tucking " or of dividing the muscle from its old attachment and sewing it forward into a new position on the globe. Tenotomy is a simple procedure, advancement an operation of some magnitude. Both require experience and skill for their successful accomplishment. Tenotomies may be safely performed at an earlier age; generally, however, it is safer to wait until the ninth or tenth year of age before attempting advancements.

As a rule, blind eyes tend to diverge, and it is generally useless to attempt to obtain parallelism in such cases by any form of operative procedure, for without the stimulus of vision to hold the eyes in fixation, such operations are usually futile, the deviations recurring after the primary effect of the readjustment of the muscles has passed.

# CHAPTER V

## THE INFLUENCE OF OPTICAL DEFECTS UPON THE GENERAL SYSTEM

It may readily be gathered from the perusal of the previous two chapters that any decided derangement in the build of the eyes or in the proper balance of the ocular muscles may, under certain conditions, exert a profound influence upon the general system, and the daily experience of all specialists in eye diseases supports this supposition.

Such phenomena are usually of reflex origin, and have their manifestation in organs which have some association with the eyes, by virtue of connections both near and remote, through the central nervous system. It is rare that these reflex symptoms arise in others than eye workers, who employ many hours daily in the close use of the eyes. At times, however, they are encountered in individuals who lead for the most part an outdoor life, with a minimum amount of eye-strain.

When it is remembered that the eye may be regarded as an end organ of the brain and that of the 12 pairs of cranial nerves 6 have some connection with the eye, and that several of these have relationship with nerves supplying other important organs of the body, it is not surprising that ocular anomalies entail more or less derangement in the functions of these organs. The degree of impressionability of the nervous system in each individual has much to do with the appearance of such reflexes, and errors of refraction which would occasion no reflexes whatever in unresponsive individuals will, in a person of nervous disposition, originate disturbances in the functions of the body of considerable moment. An examination of the eyes of such cases usually reveals an error of some magnitude.

Probably the most common symptom caused by eye strain is *headache.* Indeed, it has been estimated that 71.3 per cent. of cases who consult oculists suffer from some form of head pain. The pain from eye-strain may occur in any part of and all through the head, so that from its location alone it is impossible to differentiate headache from eye-strain from that due to other causes. Usually, however, pain over both or one eye is significant, but dull pain in the back of the head is scarcely less so, and pain in the temples and top of the head is frequently originated by eye-strain. The time of the occurrence of the head pain may, however, often establish a causal connection between it and eye-strain. Thus, it will be ascertained that a morning headache was induced by the prolonged use of the eyes the night previous. In another patient, headache will appear in the late afternoon, after an all day's labor at the desk, whereas on Sundays or holidays there is perfect freedom from all such symptoms. It must be noted, though, in this connection, that headache may be just as likely induced by the strain of regarding distant as well as near objects. In fact, in many defects of the ocular muscles, distant fixation is more apt to give rise to distress than prolonged application at close range. In this class of individuals, headache will appear in the morning after a night spent at the theatre or at a lecture, or will be occasioned by watching moving objects, as in crowds, or passing objects when seated in a trolley or railroad car. If the patient be catechised sufficiently, a connection between some unusual near or distant use of the eyes may generally be ascertained, and the clew given which will lead to the recognition of the cause of the trouble.

A large proportion of the subjects who suffer from eye-strain present no associated ocular symptoms whatsoever. Indeed, it may be put down as a rule that eyes with red lids and other signs of congestion do not, as a rule, cause headache or other reflexes. The strain seems to be relieved by the local turgescence, and head symptoms are absent. Although the eyes themselves present nothing abnormal to the casual observer, it is often possible to elicit data which are at least suggestive that they are at fault. Thus, many subjects will complain of the print blurring after prolonged reading, of restricted distant vision, of occasional double vision, in fine of those symptoms usually described under the term of *asthenopia.*

In many instances, however, there is nothing which serves to attract the attention of the sufferer to any ocular deficiency whatsoever, and the headaches are variously ascribed by him to biliousness, hunger, brain fag, and a variety of other causes. Others count themselves victims of an inherited trait and resign themselves to a life of suffering. Despite the claims of some that *migraine* or sick headache, that distressing form of recurring head pain, with associated sick stomach and vomiting, and often accompanied by various forms of visual phenomena, *i.e.,* the perception of flashes of lights, motes, etc. (*vide* p. 189) is invariably caused by eye-strain, experience teaches that while it is true that such attacks may sometimes be cured, they are more often only controlled, and oftener still entirely uninfluenced by ophthalmic treatment. While migraine may in many instances be viewed as but a peculiar variety of headache and having but little relationship with the general health, it may be symptomatic of serious disease within the brain, and its occurrence should always lead to a careful medical examination, with a view to determining its true nature.

Not only may headache be induced by eye-strain, but other reflexes may also be occasioned by it, which manifest themselves in *digestive disturbances.* These may vary from flatulency, faulty digestion and its product constipation, to nausea and actual vomiting. The accompanying schematic anatomical explanation (Fig. 25) demonstrates the connection of the nerves of the eye with those of the stomach and illustrates how such symptoms may arise. In consequence of ocular anomalies and the resultant strain, nerve energy that should have been expended elsewhere is diverted to the eyes, and the functions of the organs robbed of their proper stimulus suffer. The history of such cases is as follows: A patient who is accustomed to use his eyes much at short range suffers from indigestion almost constantly as long as he carries on his work. He interrupts his labors for a short holiday in the open air, away from his books, and his digestive symptoms vanish. He eats everything without difficulty. He returns to his desk and in a few days distress reappears. The ocular cause of his symptoms being unsuspected, his diet is looked into and certain articles of food denied him. He is enjoined to spend more time in the open air, and riding or golf is prescribed. By dint of this, of daily exercise and great caution with his diet, his work is continued with more or less discomfort and restriction. Finally some one calls his attention to his eyes and he is properly glassed, and very shortly, to his amazement and gratification, he finds that his liver no longer gets out of order and that he can take

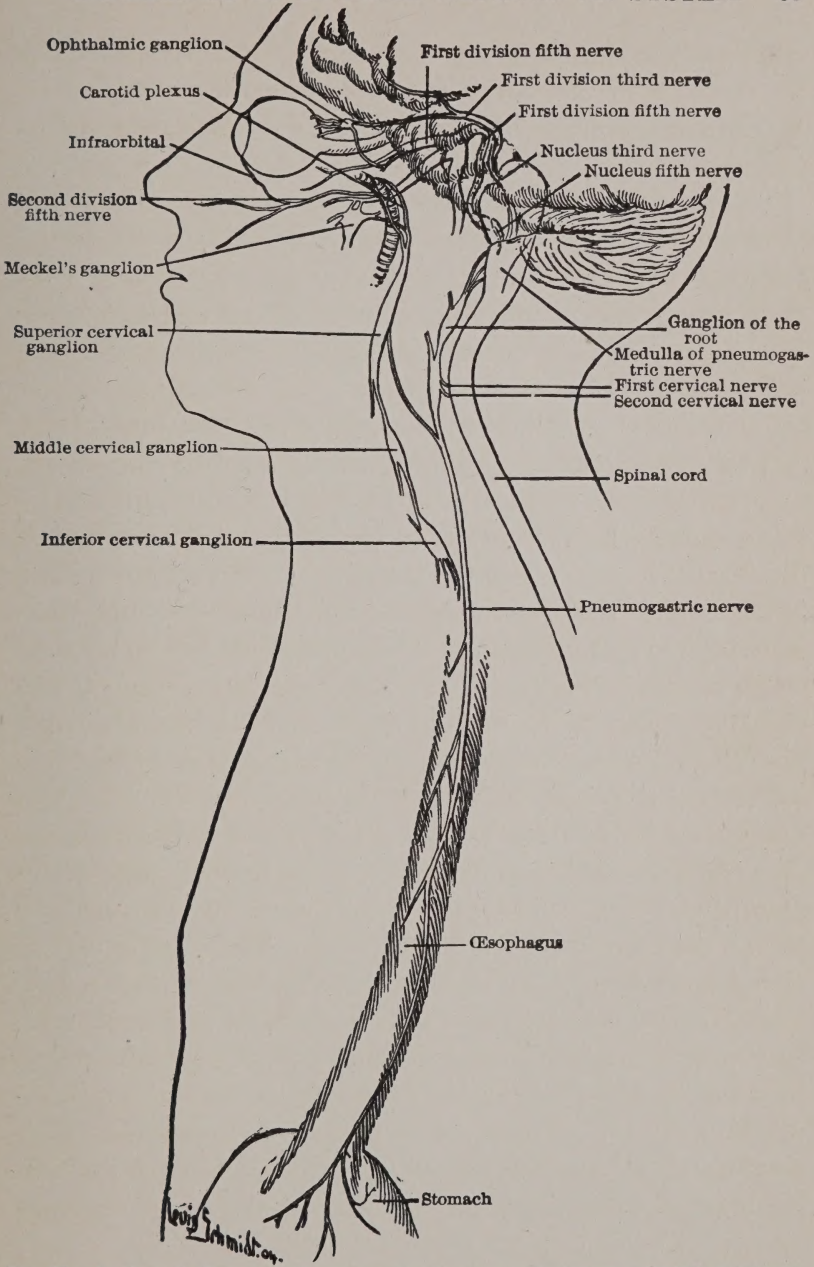


Fig. 25.—A schematic diagram of the cerebrospinal and sympathetic nerve connections between the eye and the stomach. (Hansell, Posey and Spiller, "The Eye and the Nervous System.")

decided liberties with his diet without fear of evil consequences.

The reader must not deduce from this that ocular disorders are responsible for all forms of faulty digestion; that ocular imbalance does, however, play an important contributing factor in many such cases is attested by the experience of many clinicians and ophthalmologists.

VERTIGO.—Vertigo, head swimming, or dizziness, may be due to a variety of causes. Heart disease is perhaps chiefly responsible for the majority of the cases, but any other condition of the system which temporarily or permanently affects the equilibrium may operate as a causal factor. Ocular vertigo may be occasioned by errors of refraction or faulty action of the ocular muscles, and is usually excited by the use of the eyes at near work. Where, however, it is dependent upon some gross anomaly in the functioning of the muscles, it may be present constantly, and only relieved by closing the eyes. Under such circumstances, vertigo is usually associated with double vision and the diagnosis of the ocular source of the dizziness patent.

In other instances, however, cases in which the ocular error is but slight, the most searching test is often necessary to determine the seat of the trouble. The author has in mind a man of massive build and robust health, an important personage in civic life, who was about to resign his position of responsibility on account of a troublesome vertigo which had been unrelieved by medical treatment, and who was entirely cured of the dizziness by the superposition of a weak vertical prism into his glasses. Ordinarily vertigo, when dependent upon minor ocular defects, occurs in those who are run down, or whose eyes are weakened from excessive near use. Nausea and vomiting may be attendant phenomena. The treatment of ocular vertigo may usually be accomplished by the adjustment of proper glasses, or by operation upon the eye muscles, and the cure which is usually effected earns the lasting gratitude of the patient.

CAR SICKNESS is often dependent upon the same causes as ocular vertigo and may be entirely relieved in many instances by ocular treatment.

CHOREA OR ST. VITUS' DANCE.—The frequently repeated blinking of the lids, associated at times with twitching in the muscles of the face, is often dependent upon eye-strain, and, as in the other affections just described as of reflex ocular origin, may be seen in association with apparently insignificant ocular errors, the intensity of the reflex phenomena excited by the eye-strain being less dependent upon the degree of the anomaly present than upon the impressionability of the nervous system of the individual affected.

The chorea of eye-strain must, however, be differentiated from true chorea, which is probably infectious in nature, with superadded psychical phenomena. Ocular or habit chorea usually occurs in children whose eyes are not alone at fault but whose nervous system is not equal to the strain of school life. A cessation of school work, tonics, and the like, are of service, but study cannot be resumed without a return of the grimaces, unless the correction of the ocular defect has been made.

By removing the strain upon the nerve centres and thereby lessening their sensibility to peripheral impulses, it has been found in many instances that a painstaking correction of any ocular error will often lessen, if not cure, *the habit of wetting the bed,* common with some children long past infancy.

FAULTY POSITION AND SPASMODIC MOVEMENTS OF THE HEAD DUE TO EYE-STRAIN.—In order that the body may properly perform its functions and all the organs act in harmony, a certain reciprocity must be maintained between the different parts. Nowhere is this reciprocity, this association of action, better observed than in the movements of the head and eyes. On account of the protected position of the eyes and the direction of the plane of the orbit in the human skull, the field of sight is restricted much more in man than in some of the lower animals whose eyes are much more mobile, and were it not for the increase in the range of the field of sight which the rotation of the head affords, man would be unable to perceive many side objects without change of position of the entire body. Not only does the head, however, by its movements augment the range of the field of vision, but it also supplements the action of the extra-ocular muscles in the delicate task of maintaining proper visual axes. To properly perform this two-fold task, the head is provided with numerous and intricately acting muscles, and it is only when one remembers that there is scarcely a position assumed by either the eyes or head in which the action of both parts do not enter, that we realize how intimate the relationship between the muscles of the eye and those of the neck is; indeed, it might be added the musculature of the entire body as well, for it is usual for the muscles of the trunk to be implicated in a greater or less degree in all vicarious positions of the head.

The accompanying illustrations (Fig. 26) depict faulty positions of the head assumed by individuals with paralysis of eye muscles, in consequence of a compensatory effort to

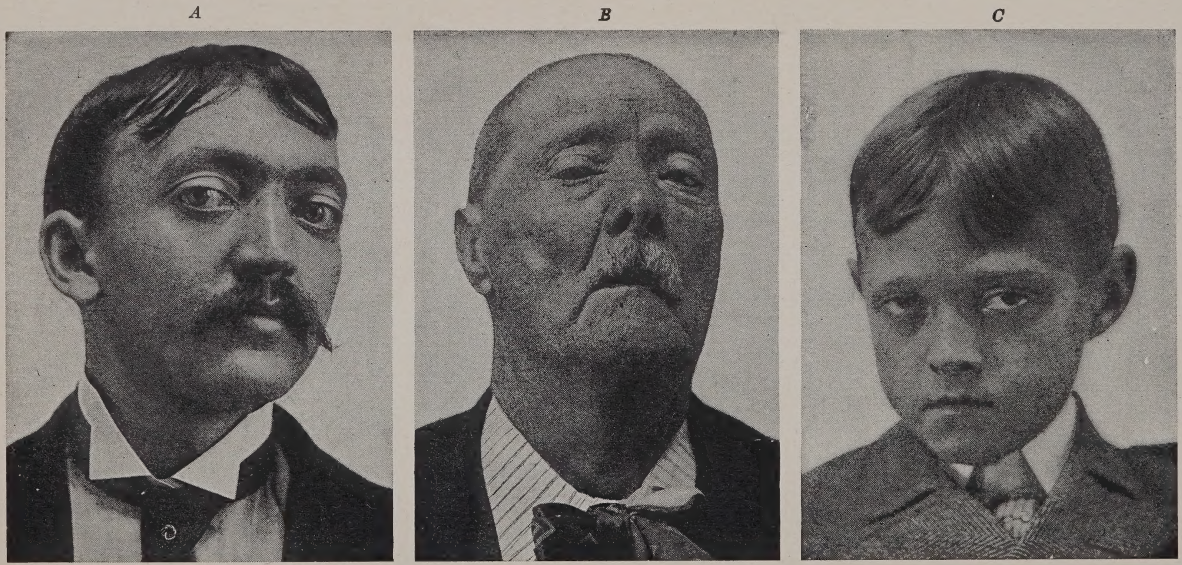


FIG. 26.—*A*, *B*, and *C*, figures illustrating compensatory positions of the head in paralysis of eye muscles. *A*, shows position assumed when the field of diplopia is to the left (paralysis of a left rotator—L. externus, R. internus). *B*, the position when the field of diplopia is up and to the left (paralysis of a left-hand elevator—L. superior rectus, R. inferior oblique). *C*, the position when the field of diplopia is down and to the right (paralysis of a right-hand depressor—R. inferior rectus, L. superior oblique). (W. T. Shoemaker in International Clinics.)

avoid the double vision and ocular vertigo occasioned by the palsy, the head being turned in the direction of the affected muscle, thereby supplementing its action, so that for every

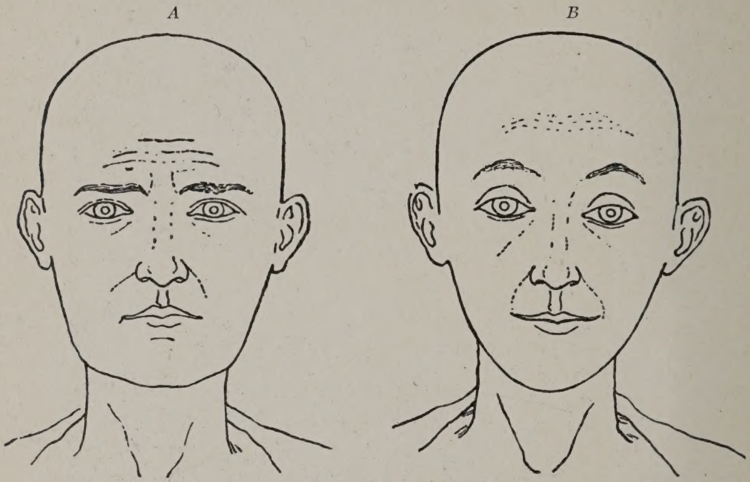


Fig. 27.—*A*, depicts the expression sometimes indicative of an overaction of the muscles pulling the eyes in. *B*, weakness in the same group of muscles (Stevens, "Motor Apparatus of Eye." Courtesy, F. A. Davis Co.)

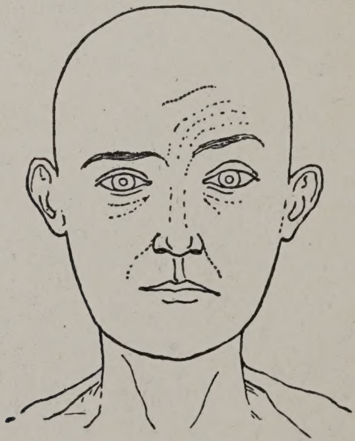


Fig. 28.—Shows the compressed brow on one side and the elevated one on the other, sometimes observable when the eyes are not on the same horizontal plane, *i.e.*, one eye looks higher than the other. (Stevens. Courtesy, F. A. Davis Co.)

variety of palsy there is a characteristic pose of the head. Similar deviations, though to a less extent, are observed in cases of latent trouble in the ocular muscles, and often are the means of calling the attention of the oculist to the faulty muscles.

Associated with the tilting of the head, and in minor degrees of anomalies of the ocular muscles, occurring without any change in the position of the head, various contractions occur in the muscles of the face, which find expression in the appearance of grooves and wrinkles, which at times entirely change the expression. The illustrations adjoining (Figs. 27 and 28) express the views of a well-known American oculist, who asserts that it is possible by a study of such changes in the lineaments to determine the particular muscles which occasion them.

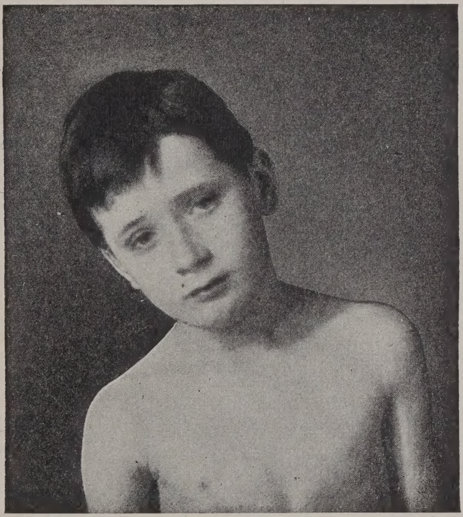


FIG. 29.—Showing torticollis from vertical deviation of one eye.

A condition of *wry-neck* which occurred in the practice of the author is illustrated by Fig. 29, the spasm in one of the principal muscles of the neck having been occasioned in consequence of an extreme tilting of the head, by the patient's effort to overcome the disturbance in vision following a paralysis of one of the muscles which elevates the eye.

Another type of cases in this group is the occurrence of *head jerking in association with oscillations of the eyeballs in young children.* In this disease the child moves its head rapidly, either from side to side or up and down, or at times with associated horizontal and vertical movements, while the eyes make rapid to and fro movements. This condition usually arises in children with rickets and other nutritional disturbances, in consequence of which the centres in the brain controlling the movements of head and eyes become impoverished at the time the child is learning to coördinate the movements of the eyes with those of the head; an initial eye lesion occurring, compensatory head movements appear.

Oscillations of the eyeball (*nystagmus*), either to and fro, rotary, or up and down, or combinations of one or all such movements, are sometimes observed. They occur for the most part in individuals with poor vision, are usually involuntary, and generally provoked by efforts to see objects clearly. Heredity is a factor in some cases, the anomalous movements in the eyeballs being transmitted from generation to generation.

Oscillations of the eyeballs may also arise in individuals whose work demands the direction of the eyes in abnormal and strained attitudes. Probably from an effort to steady the movements of the eyes and to transfer the strain from the most affected group of eye muscles, the head is often held in peculiar positions and at times develops a slight tremor. The most striking instance of this acquired form of eye movements is that observed in miners—the so-called *miner's nystagmus,* the faulty movements of the eyes originating in consequence of the unnatural position assumed by the miners in the shafts as they strike with their picks at the coal in the vein above their head. The insufficient illumination under which the work is carried on is also a contributing factor, nystagmus arising much less often in well-lighted mines. An entire cure is effected by the abandonment of mining, by prolonged rest to the eyes, and by the correction of any ocular deficiencies.

Epilepsy.—This serious disease of the nervous system, with its associated attacks or convulsions and interference with the health of the brain, has important ocular symptoms. The warnings, or "auræ," so called, which frequently make the subject of this disease aware of an approaching attack, are not infrequently connected with the eyes, and the patient's attention excited either by a sensation of muscle strain or double vision or by the appearance of some variety of visual perception (*vide* page 183).

By reason of the association of these eye symptoms with epilepsy, some have gone so far as to claim that eye-strain may actually originate the disorder, and that it needs but the careful correction of the eyes with proper lenses to effect a cure. From the author's experience in the treatment of a considerable number of such cases, in the State Hospital for the Insane at Norristown, and in the Pennsylvania Hospital for Epileptics, it would appear, however, that while the ophthalmologist can relieve and diminish the number of seizures in certain cases in which the disease has been of not too long standing, and who present some form of visual aura or subjective sign of eye-strain, he cannot cure epilepsy. It would seem proper, therefore, in view of the facts just cited, that every case of epilepsy which has not progressed into the last stages should have the benefit of a searching ophthalmological examination and a careful correction of the eyes with glasses or by operation upon the eye muscles where such is indicated. The cure of most forms of epilepsy has not yet been discovered, but our knowledge of this complex disease convinces that the ocular phenomena observed in connection with it are merely symptomatic and associated, and by no means essentially causal.

# CHAPTER VI

## SCHOOL LIFE; ALSO SOME HINTS REGARDING THE CARE OF EYES IN GENERAL

UNDER this caption may be considered the various phases of the answer to the question, " How shall I best care for my eyes, that I may conserve vision and keep my eyes in a healthy and useful state as long as I live? " It will be shown in later chapters that the eyes are healthy only so long as the body is healthy, and that ill-health is always deleterious to the organs of sight. It may be well, however, in this connection to emphasize the particular evil of bad health in childhood upon the eyes and to warn against their overuse in early life during illnesses or convalescence from them. Attacks of measles and other fevers should be followed by long periods during which the eyes are used but little at close work, for if this precaution is not followed, near-sightedness and astigmatism will likely develop in consequence of the softening and congestion of the ocular tissues which so often accompany these conditions.

Many hours daily should be spent in the open air to tone up the bodily vigor and to rest the eyes in the parallelism of the visual axes associated with regarding distant objects.

From early childhood the eyes should be carefully cleansed of mucus and the lashes freed from all tenacious particles of conjunctival secretion by morning and evening bathing with a warmed saturated solution of boracic acid. Reading or studying in the morning before breakfast, or at least before nourishment of some kind, should be discouraged.

The books and magazines read earliest should have large lettering and striking pictures and all puzzles and games should be prohibited which have small figures or dazzling combinations of form or color. Many devices in common use in kindergarten instruction are harmful, owing to the concentration of vision which they necessitate, and teachers and parents would do well to choose only those which are free from these objections. While modern architecture and the movement to insure proper housing have done much, by proper window-spacing, to insure sufficient daylight in dwellings, many houses, especially in city streets, receive insufficient light from the sun. Under such conditions, desks and playthings must be brought nearer the windows, and the children routed out of dark corners. Children should be taught from the earliest age never to gaze long upon any near objects brightly illuminated by the direct rays of the sun. Exception must be taken also to the harmful practice of riding babies in coaches while they are lying flat on their backs with the full glare of the sun falling upon their faces. All such coaches should be provided with tops and lined with some green material.

As insisted upon in another chapter, children should be protected from all toys and articles with sharp edges or points which can possibly injure the eyes.

In the chapter dealing with proper artificial lighting, valuable information is given regarding this essential to the conservation of good eyesight, but it may be emphasized in this connection that what is necessary for the eyes of adults is doubly so for the eyes of children, and that under no circumstances should children be permitted to use their eyes except under the best lighting conditions possible. When twilight supervenes, artificial lights should go on, unless the wise parent utilizes this witching hour to rest the eyes of the young by such tales and anecdotes as will serve to amuse and instruct. No reading should be permitted by the flickering light of the open fire.

School Life.—Unless under exceptional circumstance of domestic utility or necessity, children should rarely be permitted to start school life until they have passed their sixth birthday. Few are sufficiently developed or sturdy enough to properly endure either mentally or physically the discipline and exactions of application and study before that age. When there can be no home training, kindergartens are useful, but usually some supplementary form of home instruction may be instituted in earlier years, which will serve to prepare the child for understanding and appreciation of the first year of real school life.

Examination of Eyes.—Before entering upon the duties of school life, it is essential that parents and educators should have a definite knowledge of the visual condition of each child, and no child should be permitted to commence his studies until he has been subjected to a careful ocular examination. When possible, this should be made by a trained oculist and all disqualifying defects corrected by proper glasses. In the examination of the very large number of children in the public schools of the large cities, however, such expert supervision is not always feasible, and the visual tests are often necessarily performed by teachers or general medical practitioners, reference being made to the trained specialist of such cases which manifest some considerable defect.

Such tests are of paramount importance not only for the parent, who becomes acquainted for the first time with the existence of defects which may cause a relinquishing of plans for the future career of his child, but also for the child, as the correction of detected errors of refraction enables him to enter upon school life upon equal terms with his fellows with normal eyes, which would not have been the case had his visual deficiency not been recognized. In years past, too many scholars have suffered from headaches or have been adjudged stupid and backward and punished accordingly, by reason of defective vision alone. As will appear presently, special classes and individual forms of instruction have been devised for those with very poor vision, so that a thorough comprehension of the visual status has become of prime importance to all concerned in education.

School life begun, the educators in charge should see that the periods of instruction are not too prolonged (for beginners half-hour lessons are amply long), and that each period be followed by a short recess, which should never be forfeited as a punishment for bad behavior. These periods of relaxation will give the eyes opportunity to glance at objects at long range, and will permit of a change of air and scene. In the higher classes, the best authorities agree that lessons should not last more than 45 minutes, and that each should be followed by a recess of at least 15 minutes. In arranging the order of subjects for study care should be given that two periods in which the pupils use their eyes at near range should not follow each other.

The three great requisites necessary in all school rooms are the following: *adequate lighting, proper seating facilities,* and *suitable books.*

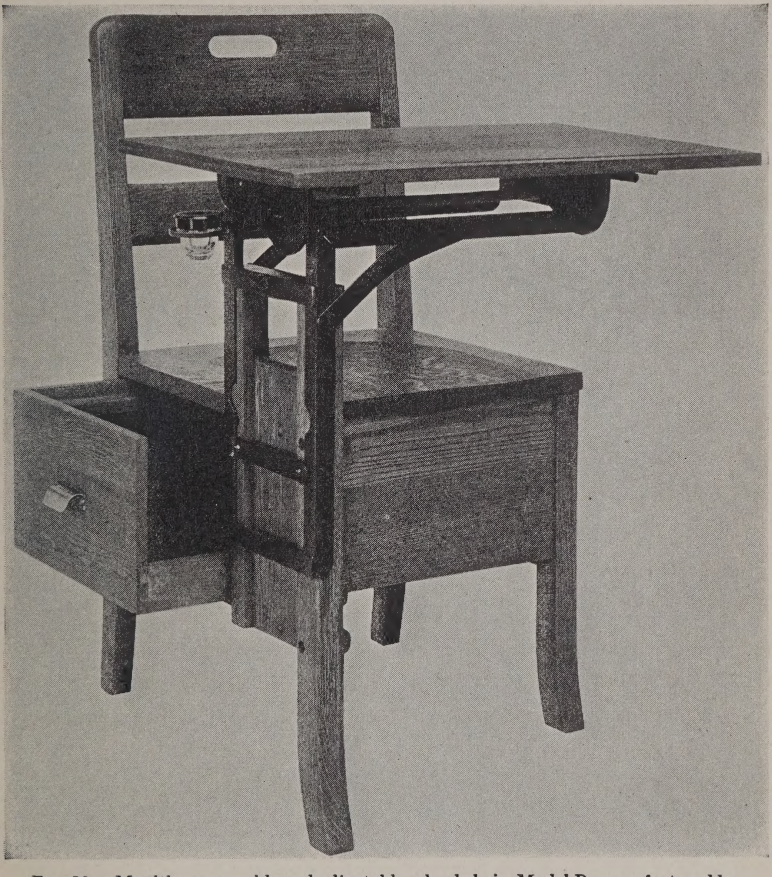


Fig. 30.—Moülthrop movable and adjustable school chair, Model B, manufactured by Langslow, Fowler Co.

The first of these has received full consideration in a special chapter. Regarding the second, the general rule should obtain that in reading, the distance of the eyes from the book should be as great as the height of the child permits. Children have a tendency to lessen the distance, both from the unconscious desire to obtain the larger image of the object which is thrown upon the retina when viewed at close range, as well as from the increased muscular fatigue consequent upon maintaining an upright posture, but this practice should be combated, as it increases eye-strain and favors the development of spinal curvature.

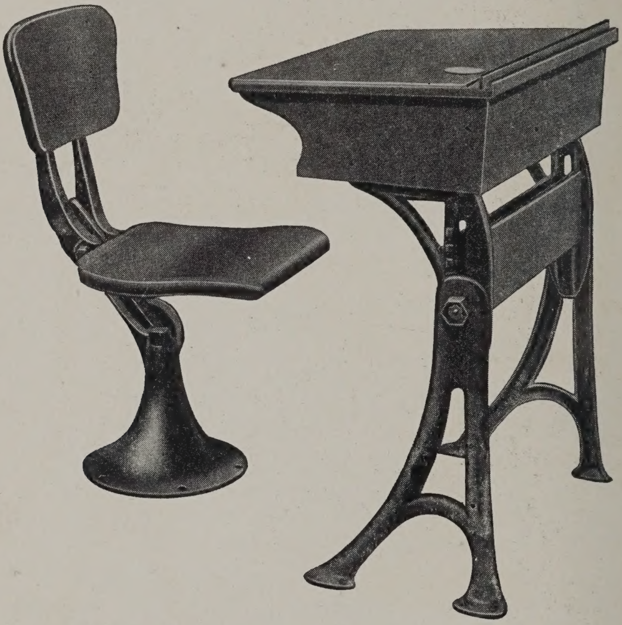


FIG. 31.—The "Princeton" adjustable desk and chair, manufactured by the New Jersey School Furniture Co.

To secure proper postural conditions, all desks should be made of adjustable parts, so that they may be fitted to the varied heights of the pupils. The tops of desks should be slanted, so that they make an angle of approximately

45° with the floor line. A distance of from 14″ to 16″ should be maintained at all times between the eyes of the pupil and the book under examination on the desk. A popular model and one which has been endorsed by Madame Montessori is shown in Fig. 30.

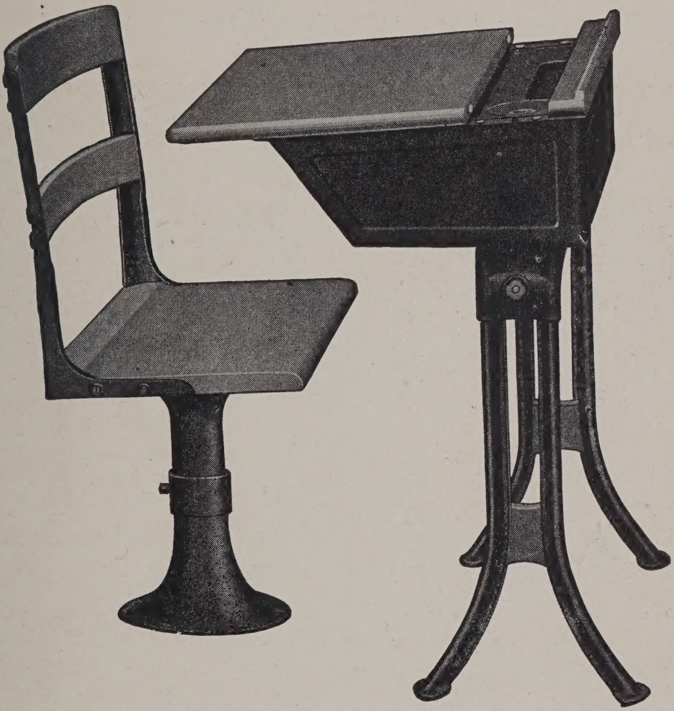
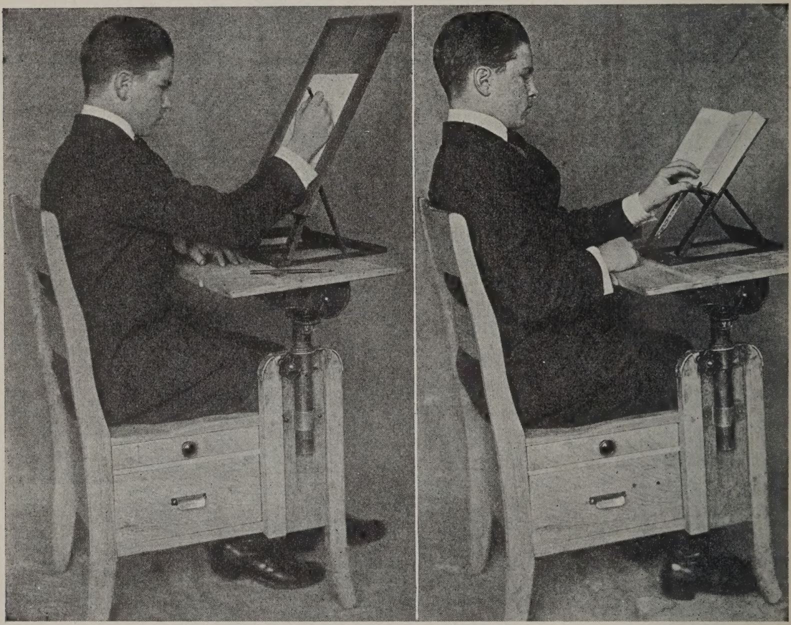


Fig. 32.—Adjustable desk and chair, manufactured by the American Seating Co.

The desk is provided with a sliding desk top, which can be pushed aside at will, to permit of the pupil's readily rising and maintaining an upright posture, a restful change after a long period of sitting. Other admirable desks are shown in Figs. 31, 32, 33, and 34.

Burgenstein, in his excellent book on " School Hygiene," recommends half-yearly measuring of the school population and allotment of seats according to the results found. He has devised a measuring rod useful for this purpose with devices marked upon it corresponding to the various sizes of desk. Faulty postures assumed at improperly adjusted desks are responsible for much evil, for not only may visual disorders arise in consequence of too little distance between the eyes and the desk, but various *spinal curvatures* may be induced which may seriously impair health throughout life. The accompanying illustration (Fig. 35) gives a graphic demonstration of one of these conditions.

Fig. 33. Fig. 34.



Figs. 33 and 34.—Adjustable racks designed by the Pastural League Society.

To relieve the eyes of the very young from the strain of close work, it has been suggested that in the first two years of school life all writing should be upon the blackboard instead of upon paper. As the slate and paper *blackboards* which are commonly in use after a time become gray from chalk dust, so that figures and letters done in white chalk are not always legible, it has been proposed to substitute mural tablets of black glass, which have the advantage of being exceedingly durable, of preserving a perfect writing surface, and of being readily cleaned by an ordinary dampened sponge or rubber. Instead of black glass boards, upon which white chalk is used, dark green boards have been introduced into a number of schools and yellow crayons used for contrast. With this exception, it is generally accepted that colored crayons should be

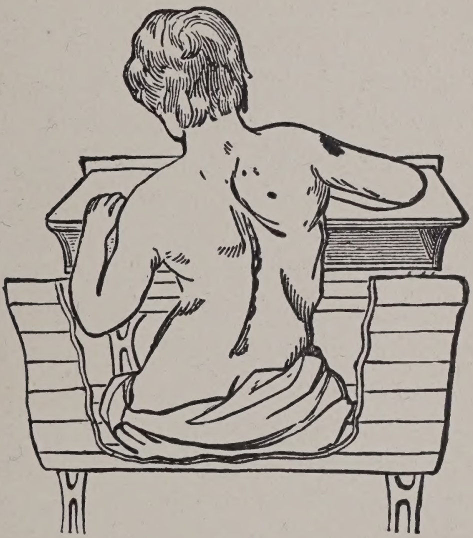


Fig. 35.—Distortion of the trunk while working at a too high desk.

used only in artistic instruction, or for such purposes as map drawing.

All blackboard work should be in large writing and the boards so placed that they receive sufficient illumination. They should never be so highly polished that reflected light from them dazzles. Large shiny blackboards on the wall opposite a window have been proven to take away much reflected light, and those with dull surfaces are always to be preferred.

When unilateral lighting is used, blackboards may safely be placed on three sides of the room. They should never be put between windows, to avoid the possibility of the direct light from the window entering the eye. When the boards are placed opposite the windows, the eyes are adjusted only to the light reflected from the board, and, if the illumination is sufficient, vision is easy and restful. The wall space opposite windows ought to be saved as much as possible for this purpose.

In well-lighted rooms, the danger from the absorption of light by blackboards is negligible. On dark days and in rooms with insufficient illumination, some relief may be obtained by drawing light colored window-shades over the blackboards. These may be fastened just above the board and pulled down when more light is needed and when the board is not in actual use.

*The style of writing* is of importance, vertical writing being conducive to a better position of body and consequent proper separation of eyes from objects regarded than the slanting variety.

Composition of Books.—Of paramount importance is the composition of the books which the child will study.

In classes for the youngest children, *i.e.,* those under seven years of age, instruction is best given by means of blackboards, large printed diagrams, pictures, and other objects readily seen at a distance, and teaching by word of mouth. After that age, only such books should be chosen as conform with recognized standards regarding paper, print, etc. Thus the paper should be without gloss, to avoid dazzling reflections. Pure white or paper slightly toned toward cream color afford the greatest contrast with the ink, which should be black. A hard pressed paper is to be preferred, as a soft paper is readily soiled, its surface easily rubbed off and the detritus injurious. The impressions of the type should never be permitted to show through from the other side, and care should be taken that there is ample time for drying the ink before the papers are bound together, to prevent blurring of the type impressions. All illustrations should be of good size and the printed text should not extend in narrow lines at the side. All explanatory legends of pictures and diagrams should be in type of a good size, which can be easily read. In preference to reproducing illustrations on highly glazed sheets, half-tone prints on matt paper should be employed.

An average length of line is to be preferred. Lines which are too long make it difficult for the eyes to pass to the next; those which are too short necessitate too frequent a change in direction of the ocular movements. Double columns should not be employed. Good margins are restful to the eye.

The size of the type-face is the most important factor in the influence of books on vision. The following specimens of type have been reproduced from a report[1] of a committee appointed by the British Association for the Advancement of Science to study the influence of school books upon eyesight. They conform with the dimensional rules proposed by the committee and show the smallest sizes which the committee regards as permissible during the age periods cited (Fig. 36).

MEDICAL SCHOOL INSPECTION has done much to improve the condition of children during school life and the attention to ocular conditions and the insistence upon the correction of all existing errors of refraction has been of the greatest value. In the year 1895, before the institution of school medical inspection in Philadelphia, out of 33,000 children entering the first grade, only 53 per cent. reached the fourth grade, and only 13 per cent. reached the eighth grade. In the year 1905, when school medical inspection started in this city, out of 34,000 children entering the first grade, 64 per cent. reached the fourth grade, and 22 per cent. the eighth grade.[2]

As Wessels has pointed out, " the correction of ocular insufficiencies not only increases the efficiency of the pupil, but has an important economic value as well, because if a child is backward and remains in the same class for two or three years, it is costing the State two or three times as

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[1] This report, obtainable at the offices of the Association, Burlington House, W., London, is of exceeding value and is recommended to all desirous of further information upon the printing of school books, etc. A paper by Black and Vaughn, of Milwaukee, entitled " Protection of the Eyes of School Children," is also of value.

[2] Lewis C. Wessels, M.D., Ophthalmologist, Bureau of Health, Philadelphia, Pa.

FIG. 36.

## AGE SEVEN TO EIGHT

This type may be used for books to be read by children from seven to eight years old. The letters are larger than the minimum given in the typographical table.

## AGE EIGHT TO NINE

This type is suitable in size for books to be read by children from eight to nine years old. The size of the letters is slightly larger than the minimum given in the typographical table.

## AGE NINE TO TWELVE

This type is the smallest suitable in size for books intended for readers over nine years old. The size of the letters is equal to the minimum given in the typographical table.

## OVER TWELVE

This type is suitable in size for books intended for practised readers over twelve years old. The size of the letters is in conformity with the smallest dimensions given in the typographical table.

much as it should to teach that child. In Philadelphia it costs about $35 per year to teach each pupil. A child is compelled to attend school between the ages of six and fourteen years inclusive, eight years in all. Under normal conditions a pupil 14 years old reaches the eighth grade at a cost to the State of $280; if on account of defective vision the child only reaches the fourth grade in that time, it has cost the State $280, but with only $140 worth of result—a loss to the State of $140. The loss to the child is considerably more, because at the age of fourteen he is likely to be put to work, poorly equipped for the struggle for existence, his earning power is curtailed for the want of an education, so he can contribute little toward his own support, that of his family, or of the State. So again the State loses, and all for the want of suitable glasses for the child." The City of Philadelphia furnishes glasses free to all those who are too poor to provide them. From 1908 to 1913, 6310 pairs of spectacles were provided in this way.

In recent years educators and ophthalmologists have realized the advantages which would be gained by pupils and teachers if scholars with poor vision received their instruction in separate classes. There has accordingly, in several centres, been instituted *special classes for children who are very highly myopic and for those who are partially sighted from other causes.* The following is an outline which has been adopted in London for the conduct of such classes[3]:

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[3] "The Problems of the Education of the High Myopes and of the Partially Sighted," N. Bishop Harman, F.R.C.S.

"1. Elementary school for easy treatment as regards eye work.

"2. Elementary school for oral teaching only.

"3. Myope class.

"4. School for the blind and partially blind.

"5. Invalided temporarily or permanently."

Harman says: "To make clear the nature of the defect of the eyes of these children and the limitation of the education they will receive, the matter is explained personally to the parent of the child, and an explanatory notice is issued. It is equally necessary that the teachers to whose care these children are committed should be clear as to the necessity for closely watching and limiting their work, and to this end a circular letter is sent to the head teacher of the school to which any such child is admitted."

In London, children with a myopia of from 5 to 15 D., and with a corrected vision varying from 6/18 to 6/24 are admitted to the myopia classes. These classes are all connected with the ordinary schools as "(1) a better scheme of work can be provided by this association; and (2) to establish the class as a separate unit is to run the risk of the children leaving school with a special mark upon them." The scheme of work outlined for these classes is as follows:

"(1) Oral teaching with the normal children for such subjects as can be taught orally.

"(2) Literary work such as is necessary for the knowledge of the ordinary means of communication to be learned without books, pens, or paper, but by the use of blackboards and chalk, the writing to be done in free-arm fashion.

"(3) A full use of every sort of handicraft that will develop attention, method, and skill, with the minimum use of the eyes."

In his valuable paper, Harman goes on to say:

"*The Class-room.*—The one necessity of a class-room for myopes is perfect natural illumination. Artificial lighting for these rooms is a negligible consideration. All work other than physical exercises, oral lessons, or games is suspended immediately artificial light is required.

"The ordinary school desk is unsuitable and the special desks in use provide for each child a full-sized blackboard suitably sloped and at a convenient height for sitting, and also a full-sized horizontal table for handiwork. It is convertible from one use to the other by merely lifting the board. Each room has fitted all around the walls a band of blackboard. The boards are fixed so that they are available for both teachers and pupils without requiring any adjustment.

"When one group of children is taking oral lessons with the normal sighted in the ordinary school, the teacher will be employed in giving lessons requiring writing, arithmetic, or manual work to another group. The number of children that any one teacher can deal with at the same time must of necessity be less than the same teacher could cope with in an ordinary school. Individual teaching is much more necessary. Further, the desk fitting—the combination blackboard and table—takes up the room of an ordinary dual desk. Experience shows that the greatest number any teacher can deal with successfully in any class working at the same subject and at the same time is twenty.

" *The Curriculum.*—The oral teaching is taken with the normal children in the ordinary school with which the myope class is associated. By this means the myopic children are kept up to the standard of knowledge of their normal colleagues, and have the benefit of mixing with them in class under the oversight of the regular teachers.

" The literary work of the children is done in the myope class upon the blackboards provided for each child, and upon the wall-boards. Letters must be large, and the chalk lines broad and strong, and to secure this the chalk supplied should be square-edged and of double the measure of the stock size. The small desk blackboards are marked with white lines two inches apart and the wall-boards four inches apart.

" In the higher standards the need of some permanent record of the work of the children is felt; and in the higher standards exercise-books are being tried of a novel pattern. They are made up of large black paper sheets, and the writing is done with white crayon, which gives a record of fair durability, but it can be washed off if desired. The exercise-books are clipped on to the desk blackboards, and the writing is done free-arm fashion as though on the blackboard, so that none of the dangers of ordinary writing, such as stooping over the work, are involved. The eldest of the pupils are allowed to make a permanent record of their work by printing. Two sets of printing types are provided for the use of each class. They are rubber faced black-letter types, one of one-inch height, the other of two-inch height. These letters are mounted on wooden blocks, and the blocks are fitted with lateral pegs and holes, so that they can be joined together to form words. The words are set up and printed upon large sheets of white paper, the record is permanent, and goes to form a class library of scrolls which are useful for subsequent teaching.

" Physical exercises enter largely into the time-table, and attempts are made to associate some of the games with the instructional work, *e.g.,* large sheets of scenic canvas are now supplied to two schools that have sufficient floor space; on these the teachers paint outline maps of different countries, marking out the position of the principal cities, rivers, mountains, etc.; the children walk about on the floor-maps, learning their geography by travelling it in miniature. With a teacher of resource such methods of instruction possess endless possibilities of interest.

" The most difficult section of the work to arrange is the manual training. Whatever the work done, it must be such that the fixed attention of the eyes is not demanded. For that reason all sewing-work is prohibited; it has been tried with a few of the elder girls but was quickly stopped. Knitting, on the other hand, fulfils the necessary conditions; a child that has any aptitude for it soon learns to do it automatically and with little use of the eyes; such children are allowed to practise it. The junior children (both boys and girls) are taught paper folding, stick laying, felt weaving in colors, and knitting. The seniors and some juniors are taught modelling maps, rough woodwork where measuring can be done with rulers marked with quarter inch marks. Advanced basket work is taught according to the advanced scheme on workshop principles (but not including raffia work, which is too fine). Bent iron-work is quite satisfactory, particularly for boys; possibly also the netting of hammocks, tennis nets, etc., for the girls cookery and laundry of a simple kind, just sufficient to give an intelligent insight into the arts of housewifery.

" These crafts are taught as a training in attention and care; it is not intended that any of the children should enter into competition with the blind in doing this work; for that reason any particular kind of this work is not continued to the point where rapidity and skill are reached. The scheme of education in view for the myopes is not merely technical but general. Many of these children are of high intelligence, and a good general training with special attention to the development of thought, initiative, a good bearing, and clear speech free from objectionable accent and idiom, will fit them for positions of usefulness and responsibility of the in- and out-door type, such as small traders, collectors, agents, visitors, etc. This kind of occupation presents no risk to the eyesight.

" There is great need for the discovery of more varieties of suitable manual work, especially for the use of the older boys. What is wanted in particular is work that can be done in the standing position. Whoever has under consideration the suitability or otherwise of manual tasks for these children has need to consider it from a totally different point of view from that necessary with ordinary children. With the ordinary child there has only to be considered the educational and disciplinary value of the work, and possibly the ultimate direct utility to the child, although I maintain that this is of no consideration in comparison with the disciplinary value. But with the myopes there is another matter to be considered. We must ask—Can the child do this particular sort of work without undue or too prolonged stooping? Judged by this test there is a great difference between such tasks as carpentry and bent-iron work. In carpentry the head is almost always bent downwards towards the bench, it is quite useless to attempt to raise the bench to a near level of the eyes to prevent stooping, for then the muscles of the arms and shoulders lose all power over the tools, and the work is unduly fatiguing. Bent iron-work, on the other hand, can be done sitting or standing, the table may be at a comparatively high level, and best of all the work is done for the most part with the eye looking straight forward. I have now under consideration the possibility of teaching weaving on frames of mats, carpets, and tapestry, work that could be done standing to frames hung on the walls. If such work as this should prove practical it will be a valuable addition to our list of suitable handicrafts.

" I should like once more to emphasize the idea that handiwork as taught in these classes for the myopes is in no sense a utilitarian affair, it is not done as an apprenticeship to a life-long work, such as is the case with the blind. It is taught as Latin is taught by the public school-master. The Latin school-master has long since given up the plea of the ' utility ' of Latin as a ' leading to vistas of classical literature,' for the logic of circumstances has driven him to admit, albeit with becoming reluctance, that his pupils never gain more than a nodding acquaintance with the language, but he is strongly entrenched behind the statement that the learning of Latin is the best of all mental disciplines. Handiwork is to the myope school what Latin is to the public school, it is the one great training in care, precision, and control.

" There is no intention of teaching a form of livelihood, but of training in methods that will subsequently be valuable in some suitable form of livelihood. This will be made plain when the various forms of work for which myopes are suitable are considered. After examining a long list of the available occupations for London boys and girls, I have drawn up the following as those for which the myopes are fit. There are two grades of work; those most suitable for them, and those of secondary suitability.

### Boys

*First selection:*

- Nursery gardening.
- Poultry farming.
- Messengers.
- Assurance agents.
- Travellers and canvassers.
- Rent collectors.
- Hawkers and street traders.
- Shopwork under good conditions.
- Piano-tuning.

*Second selection:*

- Stick and pipe mounting.
- Basket-making.
- Some branches of brush-making.

### Girls

*First selection:*

- Florists' work.
- Waitresses in tea shops.
- Dairy shops.
- Under nursemaids (no sewing).
- Creche attendants.
- Helpers at mothers' schools.
- Helpers at special schools and dining centres.

Showroom work.
Light warehouse work (packing).

*Second selection:*

Box-making.
Cork-sorting.
Envelope folding, cementing, and black-bordering.
Show-card mounting.
Some branches of brush making.
Stockroom work.

" These lists show at a glance that the kinds of work placed in the first and most suitable selection are of the outdoor type, or those that enable the worker to be out and about, standing and moving, and with a minimum of close eye work. These kinds of work are doubly suitable, for the general health is likely to be the better for the freedom of movement enjoyed, and with the improvement in the general health the state of the eyes is likely to be benefited. Next after these comes the second selections, all these are of light tasks, that do not unduly involve the use of the eyes; but they involve sitting and stooping throughout the whole period of work, conditions that are neither good for the body nor for the eyes. When, therefore, we look at the teaching and practice of manual work in the myope class in the light of the possible future of the children, it is evident that we want no more of it than is necessary to teach them methods and habits of precision. And just so much as will engage their minds with the possibilities of creating things as will withdraw them from the fatal snare of living in a world of reading and book-thinking. The manual work serves as both a discipline and a distraction."

THE PARTIALLY SIGHTED AND THE PARTIALLY BLIND.

—Under this class is grouped border-like cases which differ only from the blind in the degree to which vision has been reduced by the various diseases which have lowered visual acuity.

The conditions which are responsible for blindness in children have been classed by Harman under the following heads:

1. Blindness due to causes which are in their nature accidental.

2. Blindness due to general disease in which the child is born and shapen.

3. Blindness due to congenital deformities.

The children in the first group are normal save for lowered vision. Those in the second, however, according to Harman, which comprises 30 per cent. of the total child blind, bear the evidence of disease elsewhere, and are often mentally inferior. The third group comprises about 20 per cent. of the partially blind and is often associated with defects in other organs. In dealing with scholars in these groups Harman states: " The state of their vision cannot be the sole determining factors of their places of education; the likelihood of their educability in view of the nature of the disease that made their eyes defective must be considered, and also the possibility of this same disease reasserting its maleficent influence and destroying still further both sight and wits. The case of a child with damaged eyes the result of ophthalmia neonatorum is simple of determination, if it sees 6/18 it is a fit subject for a myope class, its wits are as likely to be good as any ordinary child, and there is no likelihood of the recurrence of the inflammation of the eyes that damaged the sight in the beginning. It is otherwise with the child whose eyes have been damaged by some inflammation springing from a syphilitic inheritance. That disease affects the whole body, and there is too often a recurrence of the disease that will still further reduce sight or even destroy the remnant, and at the same time so benumb the mental faculties as to lay waste all past educational gain, and effectually prevent any future effort. With such a child the admission to a myope class, even though justified by the character of the vision existing at the time of examination, must be the subject of special note, that the child be not pressed or allowed to enter into competition with its short-sighted and smart-witted colleagues, lest the strain of the work reduce its bodily resistance and induce a relapse of the disease that originally brought it there."

Special classes for children with defective eyesight have been in operation in Boston and Cleveland for several years past and are about to be installed in several other American cities.[4]

## Some Hints Regarding the Care of the Eyes in General

While the importance of properly caring for the eyes is not as great in adults as in children, the formative period of the growth of the eye having passed and with it the greatest danger to the development of ocular errors, nevertheless the eye remains a more or less sensitive organ until death, and the wise man will naturally conserve its strength as far as he is able. With the extraordinary demands placed upon the eyes by reason of the increased desire to read, through the multiplicity of magazines and books which are constantly published and the ease afforded their use by the excellence of present-day artificial lighting, there is much danger of the abuse of these organs. Common-sense dictates, therefore, that short periods of rest should interrupt all kinds of close work, during which the eyes should be directed for a time out of the window or on distant objects. After a day of continuous application in office work, it is unwise to devote more than an hour or possibly two hours to reading in the evening. A word of caution may be addressed to those who make a practice of *reading in a recumbent posture,* for under such circumstances it is difficult to regard the book at a favorable angle. If for any reason, such as illness or fatigue, reading must be pursued in this attitude, care should be given that the body is made as upright as possible, and that the object regarded is held well below the horizontal plane of the eyes.

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[4] Those interested in the education of children with defective eyesight would do well to obtain "The Eighth Annual Report of the Massachusetts Commission for the Blind, 1914."

Reading or close work should never be persisted in when drowsy or physically tired. The ocular muscles are relaxed under such conditions and are only stimulated into action by a conscious effort of the will.

*Veils,* though usually worn for other purposes, may be useful in protecting the eyes from glare and dust. Light chiffon veils are useful for this purpose, black, blue, and green being the preferable colors. Dotted and very thick veins should never be worn.

Books printed in very small type or on poor paper should be discarded, and better editions obtained. On account of the attendant vibrations, reading on trains and moving vehicles of all kinds is more or less injurious and should never be practised by a poor illumination. Individuals with weak eyes should reduce their newspaper reading to a minimum and this only in a good light, on account of the poor type and paper generally used in this popular form of literature.

As the health of the eyes is dependent in large measure upon the health of the body, it behooves the individual solicitous of his ocular strength to properly care for his physical condition. One or more hours should be spent daily in the open air and walking should be practised when the more active exercises cannot for any reason be indulged in. A plentiful supply of fresh air should enter the sleeping-room, which should be absolutely free from light of any kind. The bowels must be kept regulated and particular care given the teeth and the nasal passages, as disorders of these neighboring structures frequently give rise to ocular symptoms.

If the eyes feel hot and uncomfortable after exposure to irritants or undue strain, they may be washed with an eye bath containing a saturated solution of boracic acid. Bathing the closed lids with either very warm or cold water is refreshing and beneficial. The habit practised by some of partially immersing the head and opening and closing the eyes under water is not to be recommended.

Certain amusements at present much in vogue are somewhat harmful to the eyes. Among these may be mentioned automobiling in open cars and the moving picture theatres. The former is tiring by reason of the rapidity with which the eyes must adapt themselves to passing objects and from the fixed gaze of the driver and his anxious passengers upon the road. Suitable goggles will relieve the irritation of the eyes from wind and dust.

Moving Pictures.—While the great majority of those who suffer from eye-strain after watching moving pictures can usually obtain relief from properly fitted glasses, the character of the films is sometimes of such a nature that there is no escape from more or less ocular pain, even though they be regarded for a comparatively short time. Usually the promoters of moving picture theatres, alive to the demands of the public, furnish excellent films and do what they can to insure the comfort of their patrons. Motion pictures, however, have become such a universal source of instruction as well as amusement, that it seems wise to insist upon several essentials in regard to them. In the first place, glass screens should be preferred to all others, this type of screen producing an ideal reflecting surface and producing pictures without glare and with a minimum of distortion. Experts agree that the auditorium should be as light as possible without obscuring satisfactory detail in the picture. The indirect system of lighting is to be preferred for this purpose.

When possible, a seat should be chosen near the centre of the house, and within natural limits, the farther one is seated from the screen the better. Films should be discarded after they become scratched and "rainy." Steadiness and the absence of flicker in the picture may be obtained by mounting the projecting machine on a solid foundation, by proper apparatus and skilful adjustment by a capable operator. Finally, a period of rest should be permitted between the reels to offset the fatigue of concentration.

Automobiling.—In addition to irritation and strain upon the eyes occasioned by automobiling already referred to, there is another ocular phase of this popular means of locomotion which demands consideration; namely, the necessity that the driver of the car possesses a requisite amount of sight. Many European cities assure this before granting a chauffeur's license, and it would be well if this practice were generally adopted in our own country. Two good eyes are essential, for a restricted vision in one eye limits the field of vision below the safety point. Nearsighted drivers who depend upon lenses to give them adequate vision, should be rejected, as the exposure to rain and fog which is at times necessitated in bad weather, mists the glasses to such an extent that they become useless.

# CHAPTER VII

# ARTIFICIAL LIGHTING

### By Herbert E. Ives, Ph.D.

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## INTRODUCTION—ABOUT KINDS OF LIGHTS

Good artificial lighting is not a question of the kind of illuminant but of how the illuminant is used. Oil, gas, and electricity can each be used to produce satisfactory lighting, and each can be abused. The modern lighting specialist can so plan a scheme of illumination that any kind of light may be employed to give the desired lighting effect, and none but an expert can tell which kind it is. The whole problem of satisfactory artificial lighting (given a steady unflickering light such as all modern illuminants are) is a matter of the proper disposition of the light with respect to the objects to be lighted, and with respect to the people who are to see these objects.

A Very Important Fundamental.—The most fundamental principle of good artificial lighting is that the light must shine on the object of interest but not in the eyes of the observer (Figs. 37 and 38). All shades, globes, reflectors, and special arrangements of the light with respect to the walls and ceilings, if correctly conceived, should have this simple object constantly in view. Other features are to be sought as well, as is shown later, but this is the chief. Try, as an experiment, looking at a picture, first with an unshielded light alongside and a little in front, then with the light

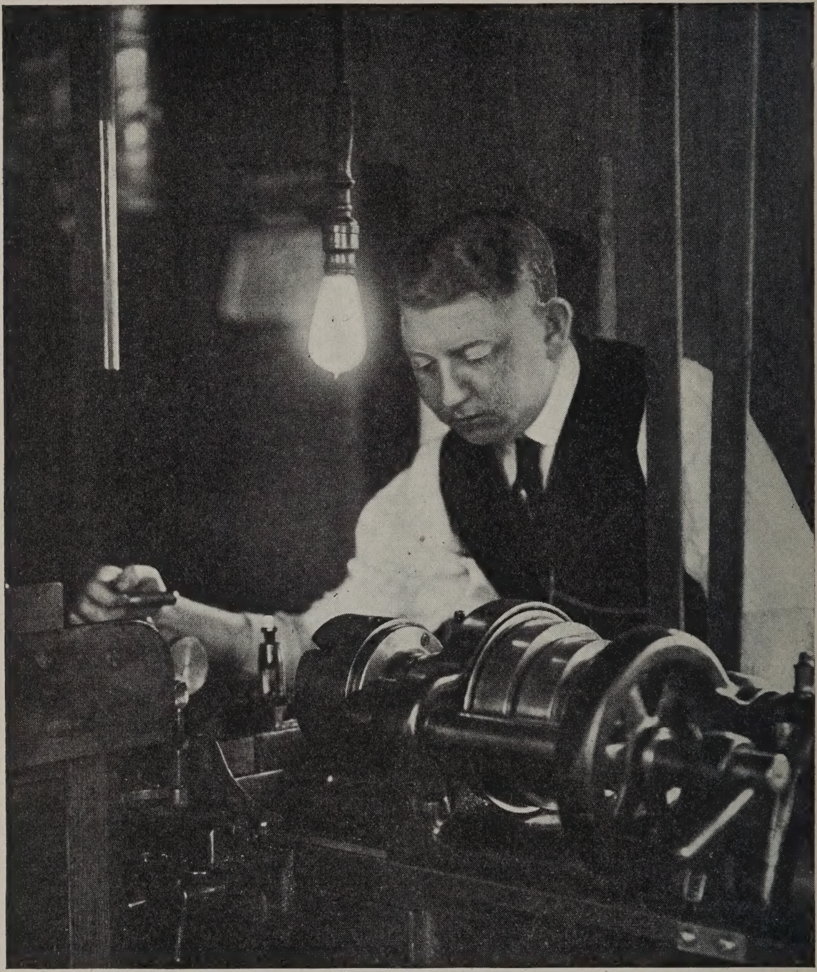

FIG. 37.—The wrong way to use a light. It shines in the workman's eyes and decreases his ability to see his work. The eyes should never be exposed to an unshielded light source.

shielded from the eyes, say with the hand. In one case the eyes are blinded with the light; in the other the picture is clearly seen, although no more light falls on it than before. Light falling in the eyes instead of on the object is twice lost.

Shades and Reflectors.—Never let an unshielded light be visible. At the same time, the effort should be made to let a large part of the light fall on the object of interest—the book page, the sewing, the machine (Figs. 39 and 40). To achieve this double object, shades and reflectors of various types are essential. A *shade* is in general a mere obstacle

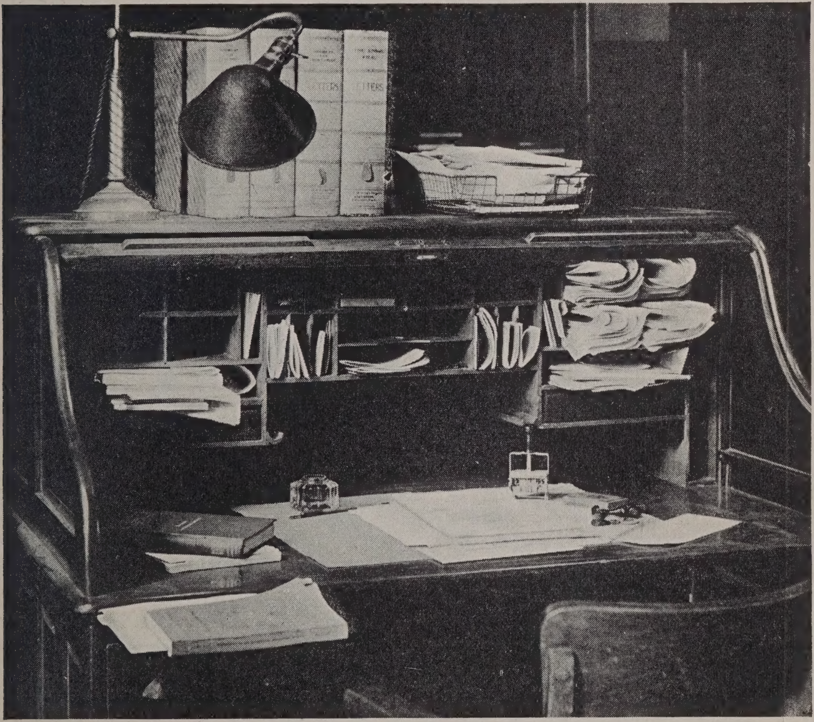

Fig. 38.—A good way to light a desk. The lamp is completely shielded from the worker's eyes by the opaque reflector, which at the same time throws a flood of light on the desk. By placing the light to the left side the shadows fall correctly for writing, and reflections from glossy paper surfaces are directed away from the eyes. A desk light alone is not sufficient for comfort, but should be supplemented by some general diffused illumination.

or screen, interposed between the source of light and the eye. It may, for instance, be a cylinder of opaque or translucent material about a table lamp, permitting the unobstructed light to go upward and downward, but not horizontally toward the eye. Or it may be a half cylinder in front of a wall bracket, permitting the light to go up-

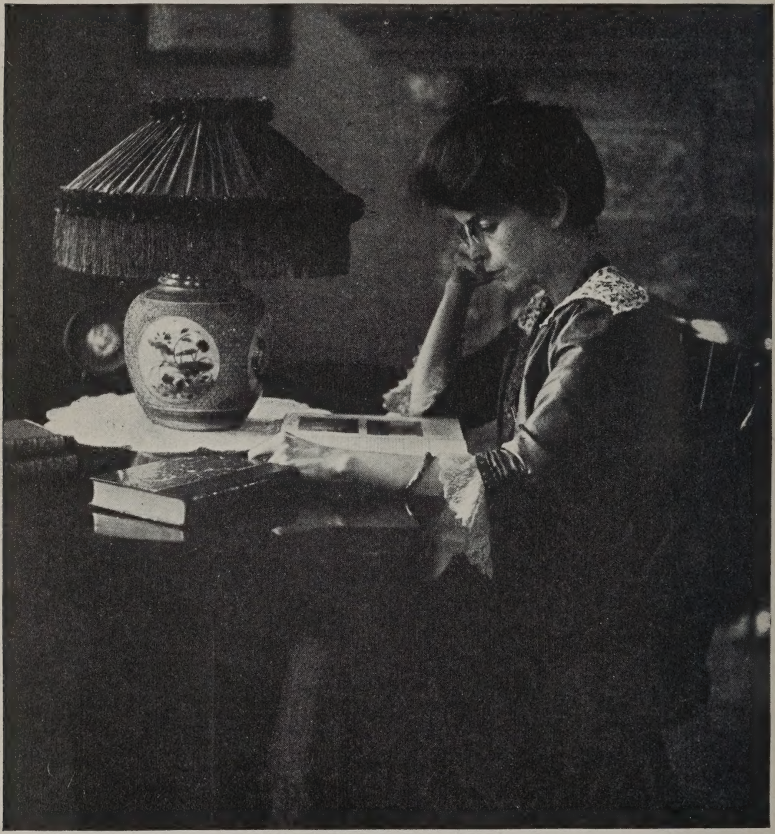

FIG. 39.—The wrong way to use a table lamp. Dazzling reflected images of the light come from the book page and polished table top, and cannot be escaped by the reader in this position. This condition is almost but not quite as bad as though the lamp had no shade to prevent the light from shining directly into the eyes. Avoid fringes on lamp shades. Their wavering shadows are excessively trying to the eyes.

ward, downward and to the wall, but not straight out. A *reflector* differs from a mere shade in that its inner surface is highly reflecting, and so shaped as to direct the light in a definite direction. Thus there are reflectors which concentrate the light over a small space, such as a desk top, and other reflectors which spread the light over large

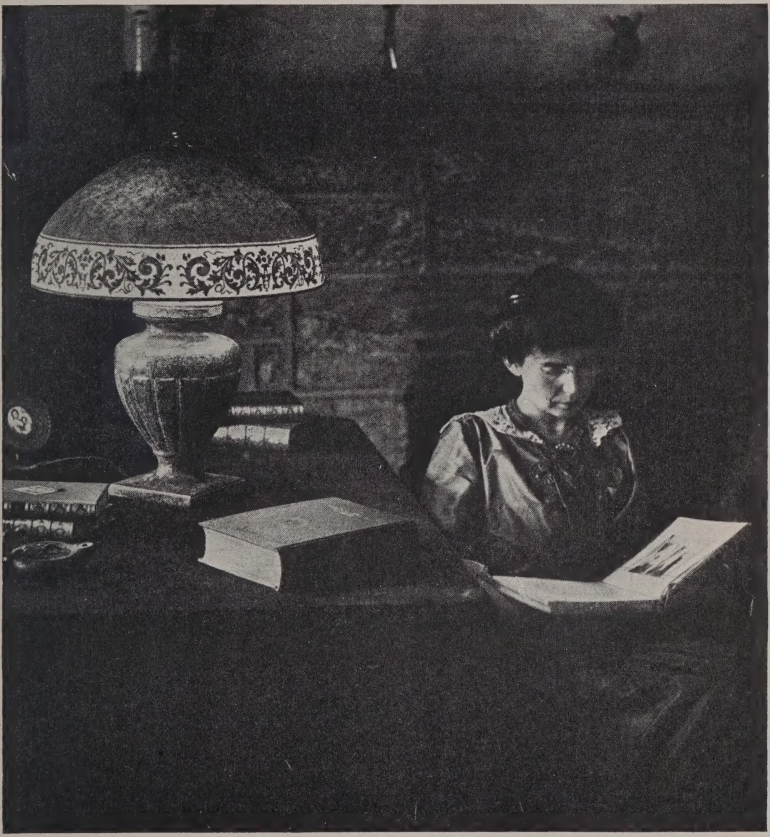

FIG. 40.—The correct way to use a table lamp. The table is provided with a dull cover, and the book is held sideways to the light, which for reading may come from either side, or over either shoulder. No disturbing reflections reach the eyes. A table lamp alone is not sufficient light for a room, unless it has an open top which throws light to the ceiling and thus provides general diffused lighting to help out the locally intense illumination.

areas, such as the floor of a room. Close, fine, difficult work will often call for the concentration of light given only by a properly selected reflector. A reflector is not necessarily a shade, but in all ordinary cases it should be. If the light source is not concealed by the reflector, or at least greatly reduced in brightness, for the normal position of the user of the light, it is not correctly designed.

LARGE AND SMALL LIGHT SOURCES—THEIR CHARACTERISTICS.—A simple but useful way to classify artificial light sources is by size. We have light sources of small area, such as an incandescent electric lamp filament, or a gas mantle. We have light sources of large area, such as an illuminated ceiling or side-wall, either of which serves as the real illuminator of the room, even though the light originally comes from a small point-like source.

The illuminations due to these two classes of light sources are called respectively *directed* and *diffused* illumination or lighting. By directed light we get sharply defined shadows. By diffused light the shadows become indefinite or soft, and can even be practically missing, if the source of diffused light be large enough. Each kind of lighting has its place. Directed lighting, with its definite shadows, is adapted to places where differences in the relief of various parts must be readily appreciated, as in type setting, some kinds of sewing, and other localized work, especially if the light falls somewhat from the side. Diffused lighting, with its absence of contrasting illuminated and shadowed spots, is adapted to large spaces where all parts should have some light—to general rather than localized activities. It goes around corners and lights those places which a directed light would leave in objectionable obscurity.

The difference in the kind of illumination provided by large and small light sources is not the only important difference between them. A large area light source is much less annoying to look at than a small one of the same light giving power. True it is that the light source should never be looked at, but it often happens that it obtrudes itself into the field of vision in a way that cannot be entirely avoided. For instance, where work is being done on polished metalware many bright surfaces reflect the light source to the eyes, in practically undiminished brilliancy. In such cases the only relief—and it is only partial at that—is to spread out the light source as much as possible, thereby making it less brilliant, and so less irritating. This can be done by covering the light with an opal or milk glass, by frosting the lamp bulb, if it is an electric light, or by directing the light upon a large dull white surface—the wall or the ceiling—which then becomes the light source.

All modern light sources are too bright to be looked at directly, and in order to minimize the dangers due to their being accidentally seen they should be spread out by diffusing surfaces as much as is compatible with the kind of work for which they are to be used. Usually even where directed light is essential the electric lamp filament or gas mantle can be enclosed in a diffusing device, such as a frosted or opal globe or reflector, which will enormously reduce its annoying character if directly viewed, but will at the same time leave it small enough to give the necessary relief-revealing shadows.

CONTRASTS TO BE AVOIDED.—Beside the question of the actual brightness of a light, which has just been discussed, is the question of the contrast it makes with its background or surroundings. If a gas mantle is viewed against the bright sky in the day-time it is so little different in brightness that it causes no discomfort. But against the black night sky it is well nigh unbearable. This illustrates the importance of preventing big contrasts between either the lighting devices and their backgrounds, or between the light and dark parts of the field of view. No light source—by which is here meant the entire lighting device as seen, shade or reflector and all—should be in such contrast with its immediate surroundings that these may not be looked at in entire comfort at the same time as the light. A bare electric lamp in a wall bracket on a dark wood panelled wall forms a contrast to which the eye should never be subjected. The various illuminated objects in a room should never be so different in brightness that the eye is strained in attempting to look from one to another, or must wait a perceptible period to become adapted, as it is called. The practice of working at a table brightly illuminated by a lamp which is the only light in the room is to be condemned for this reason. On looking away from the table the eye practically falls over a light precipice.

THE DIRECTION OF LIGHTING.—Entirely satisfactory lighting is not merely a question of avoiding irritating or annoying conditions. The illuminated room must be pleasing in appearance—it must appeal to the esthetic sense, and to our accustomed ideas of fitness. Probably nothing contributes more to this aspect of lighting than the direction from which the light comes, and the part of the room on which the major part of the light falls. The commonest arrangement of lighting fixtures is that which makes the light come from directly above, but this is probably the least pleasing direction of all. Shadows then fall directly downward, resulting in a loss of our power to properly appreciate the sizes and positions of objects. Artists have long recognized that nature looks its best when lighted by the rising or the setting sun, and looks its worst when the sun beats straight down. For the same reason that a tree is a more pleasing sight when its shadow falls away to one side than when the shadow is a mere blotch about its root, so a room with a goodly share of its light striking across it is more satisfactory than if lighted solely from above (Fig. 41).

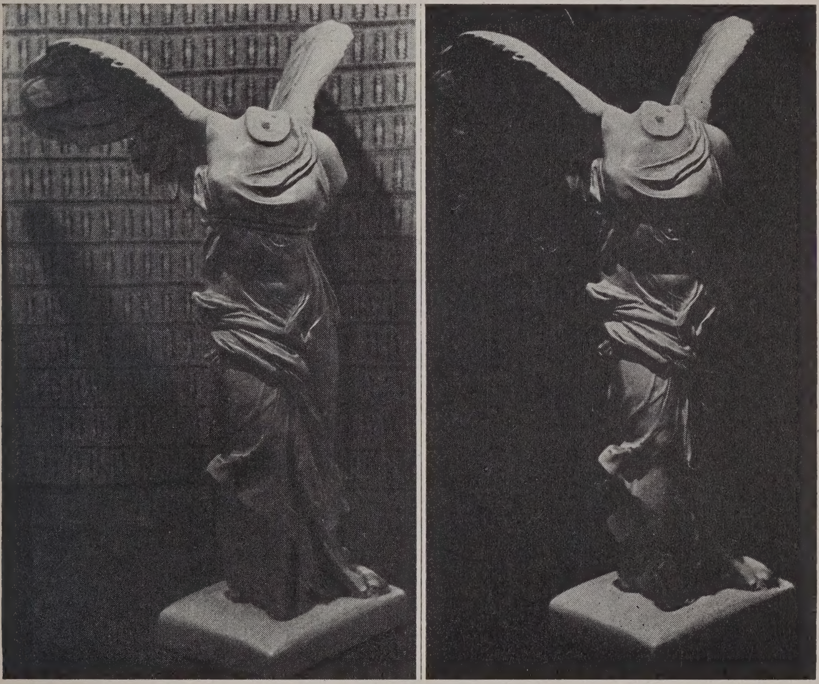

Fig. 41.—Dark walls waste light and prevent diffusion. These two booths are illuminated by exactly the same light. In the one with light walls, all the details of the statue are illuminated; in the other the statue shows only by harsh contrasts.

For the best appearance of a room it is necessary to yield in some degree to what we have become accustomed to by day, and to some of the characteristics of our furnishings which owe their origin to daylight conditions. Most daylighting of interiors is by windows facing the sun or sky. A very large amount of light falls from the window to the floor and on to comparatively dark floor coverings and furniture. If our room by night is not to look topheavy and gloomy, it is desirable to throw a large amount of our artificial light to the floor and furniture.

Yet another concession to our ingrained idea of fitness is to avoid concealing entirely the point of origin of the light. The light source is a centre of cheer and no mean part of the decorative makeup of the comfortable room. Where the lighting is entirely diffused, much of the life and coziness of the room is lost. But this natural yearning for an unmistakable centre of light radiation does not by any means call for a dazzling light shining in the eyes. It is quite sufficient for the shade or reflector surrounding the lamp to be a little brighter than its surroundings in order to satisfy this psychological need. Chief dependence should be placed on the clear revealing of the direction from which the light comes, by the naturally greater illumination near the light source and by the direction in which the shadows fall.

THE MOST SATISFACTORY ARRANGEMENT OF LIGHTS. —In the nature of things there cannot be a standardized arrangement of lights to give the best effect, because every kind of room and every use to which a room is put makes different demands. But in general it may be said that the problem of satisfactory lighting—assuming that the necessary precautions as to concealing the light sources, avoiding contrasts, and so on, have been observed—reduces to finding the proper balance between directed and diffused light, and between the amounts of light in the various parts of the room. Extremes are to be avoided. Thus entirely diffused lighting produces a dead, fog-like effect.

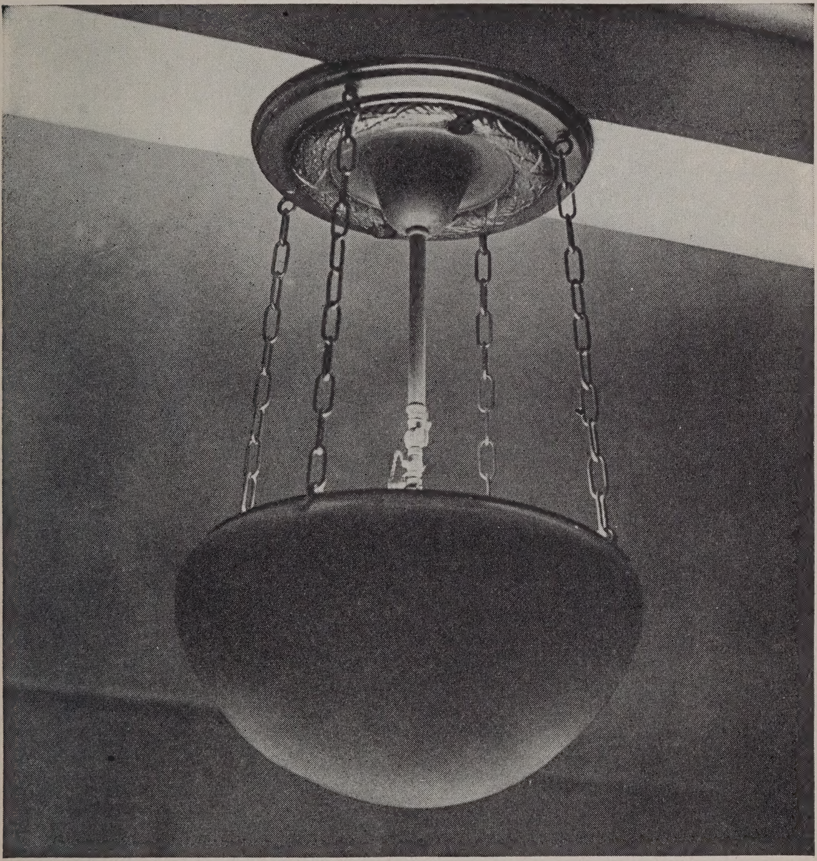

Fig. 42.—A common type of fixture planned to give diffused illumination. The light source is in the opaque bowl which reflects the light rays upward to the ceiling. Used alone this type of fixture is apt to be inadequate, because the lower part of the room is deficient in light. It should be helped out either by pendent lamps to give downward directed light, or by table lamps.

On the other hand, too exclusively directed a light is apt to result in violent contrasts of light and shadow (Figs. 42, 43, and 44).

A safe rule is that there should be enough diffused light, from illuminated walls and ceiling, so that all parts of the room can be clearly seen. To this add directed light at the points of interest—the work table, piano, or book page. The amount of this directed light will vary greatly according to the kind of room. In the dining-room a very considerable concentration of light on the table is permissi-

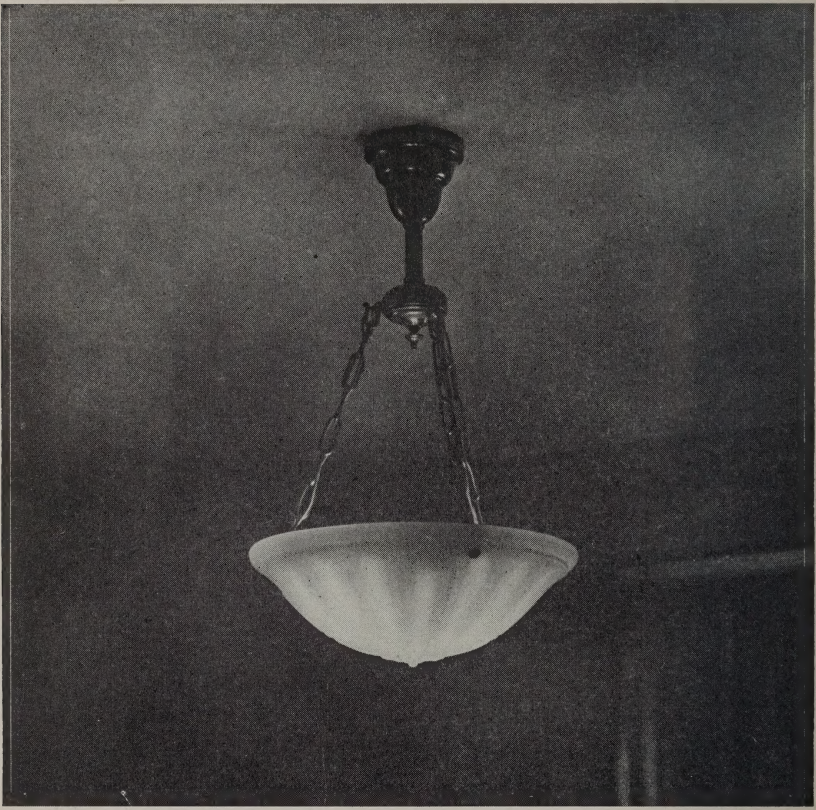

Fig. 43.—Another type of fixture designed to give diffused illumination. A translucent bowl, forming with the ceiling, a large area light source. In a small room this type of light may suffice for both general illumination and for the work table or desk. If so used it should be placed high enough over the desk to be well out of the line of vision, or should be behind and to the left of the worker.

ble and desirable. In the small living-room or library, rather strong local lighting makes for coziness. But in a public auditorium or ball-room all parts demand nearly

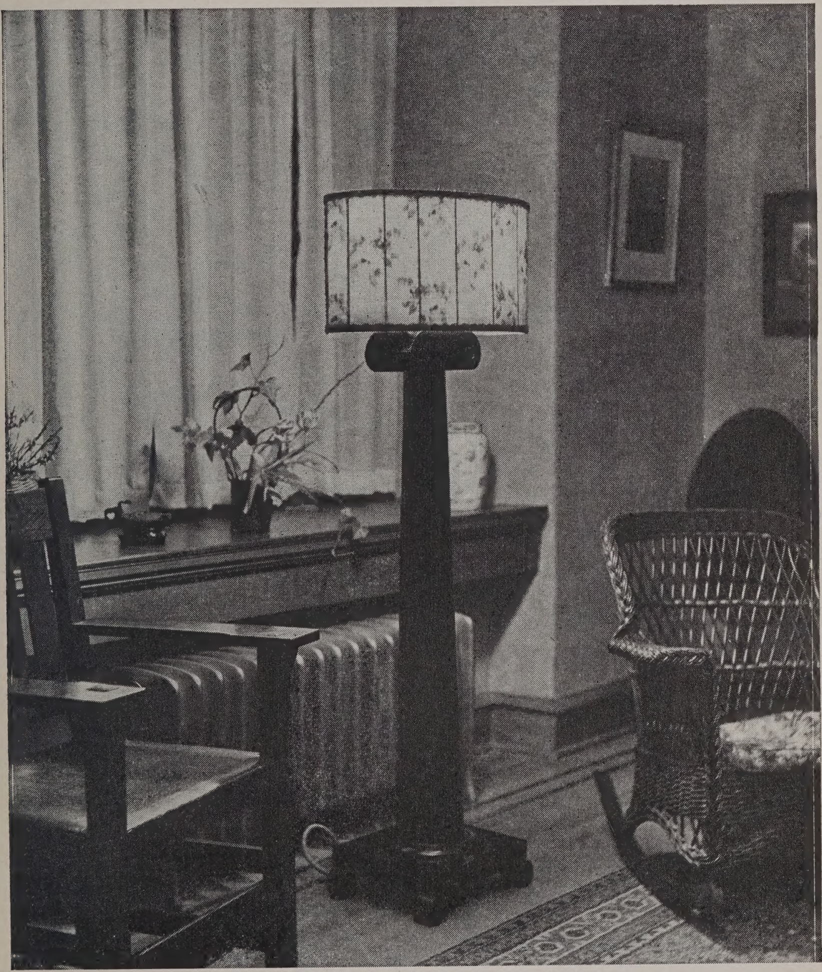

Fig. 44.—A well-considered side-wall light. Bright lamps against dark walls are all too common. In this floor standard the light is concealed by a large area, low brightness shade, which obscures it only from the direction of the room. In back the light falls on the white window curtains, which with the ceiling and floor serve as sources of diffused light. Directed light passing out beneath the shade illuminates book page or work.

the same amount of light, which may be accomplished by a very high intensity of diffused light or by many well-distributed local directed lights.

Lighting Fixtures.—The practical working out of the principles of lighting depends upon the placing of the piping or wiring outlets, and on the choice of lighting fixtures. The ideal way is to plan the lighting with the house, keeping definitely in mind the use of each room, together with the kind of furniture and its arrangement. But more often than not the outlets are already in place when the future occupant of the room first sees it, and the whole problem becomes one of choosing fixtures to make the best use of the outlets provided. These are not always in the best places, and even if they have been properly placed on the expectation of a certain use for the room, they may not suit the use for which the room is later put. It is always a safe thing, and usually possible, to have additional baseboard or other portable lamp connections installed. These permit the use of different forms of fixtures, according to the use to which the room is put or the taste of the occupant.

Four types of lighting fixture are available, classified according to the mode of support, or the position they occupy in the room—ceiling fixtures, wall brackets, floor standards, and table lamps or " portables." In each of these forms examples are to be found planned to give entirely diffused, entirely directed, or mixed illumination. Where there are several outlets the proper balance can be secured by a combination of a diffused lighting fixture with directed ones. For instance, the diffused light may come from a ceiling fixture of the suspended bowl type, the directed from a table lamp or floor standard which may direct all its light downward, either of these alone not being fully satisfactory. Where there is but one outlet a fixture to give both the diffused and the directed light should be chosen. Such, for instance, is a table lamp which not only sends light down to the table, but through its open top sends light to the ceiling to be there diffusely reflected to all parts of the room.

A cardinal rule in the selection of lighting fixtures is that they should be chosen not because they look well as examples of metal and glass work by day, but for their appearance and performance at night when lighted. Artistic appearance is very desirable, but it should be in addition to, not at the expense of, serviceability.

OTHER THINGS NEARLY AS IMPORTANT AS THE LIGHTS THEMSELVES.—Furniture and wall coverings are a vital part of the lighting scheme of the room. Dark walls absorb light, thus demanding the use of more gas or electricity to give adequate illumination. But more serious than the loss of light caused by dark walls or ceiling is the fact that with them it is almost impossible to obtain an adequate amount of diffused light, or to avoid excessive contrasts between lighted and unlighted objects. Walls, and especially ceilings, should be light. Dark wood wall panelling, and carved wood ceilings, which we copy from our Elizabethan ancestors who lived mostly by daylight, are practically incompatible with efficient or comfortable artificial lighting.

Glossy surfaces should be carefully avoided in the furniture or objects used in a room. A polished table top, or one covered with a glass plate, reflects the unshielded light of the table lamp or overhead fixture directly into the eyes, and is just as bad as never-to-be-faced unconcealed light. Books or magazines printed on glossy paper are to be shunned for this same reason. Fortunately publishers are being brought to a realization of the evil effects on eyesight of glazed paper reflections, so that this source of glare may before long be done away with.

Another thing nearly as important as the placing of the lights is the position of the occupant of the room. Even in rooms where the lights are poorly arranged it is often possible for a person to so place himself that the annoying lights are no longer seen. So too, in reading or writing, such disturbing reflections as may come from paper or table top can be escaped by having the light come from the side or over the shoulder. A safe rule is never to face the point from which the light comes.

Finally, let it be remembered that if the lighting seems unsatisfactory it may mean nothing more than that the eyes have become tired from their day's work before the artificial light is used at all. The remedy may lie in the hands of the oculist instead of the lighting expert.

Quantity of Light.—The quantity of light to be provided for is one of the first things considered by the illuminating engineer. It should be about the last thing for the layman to attempt to make a judgment upon. This is because the layman is altogether too apt to be led astray by any one of half a dozen other defects of a lighting system, which must first be removed before it is possible to decide whether the amount of light is sufficient. Never conclude that more light is needed until every light now used is properly shielded, until all excessive contrasts have been remedied, until all glossy reflections have been done away with. If then there is difficulty in seeing well enough for the work in hand, the lighting units may be increased in size, or more added. It is quite futile to attempt to improve the lighting by adding more light if every addition of light adds an equal amount of glare.

# CHAPTER VIII

# DAYLIGHT ILLUMINATION OF ROOMS AND BUILDINGS FROM AN ARCHITECTURAL STANDPOINT

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As a civilized man spends, in all probability, considerably more than one-half of his time " under cover," the lighting of buildings, both natural and artificial, as an economic factor, has not, until quite recently, been fully recognized. This is undoubtedly due to the fact that the study of lighting systems has not been considered apart from utilitarian, structural, or architectural considerations.

Artificial Lighting.—The introduction of artificial lighting units of great intensity, such as the arc light, and the high powered incandescent electric and gas lamp, was probably the determining consideration in the study of methods whereby the intensity of light could be mellowed by equitable diffusion, and in the last few years the investigations along this line have been productive of far-reaching results in the artificial lighting of buildings. It seems remarkable in looking back over the crude and unsuccessful attempts at lighting which were prevalent in the quite recent past that devices for diffusing artificial light were not devised long ago. The possibility of simulating daylight by artificial means, and particularly in such parts of buildings as it is not possible or desirable to introduce natural light, such as large areas below pavement levels, floor areas not adjacent to windows, and in auditoriums where external sounds had to be eliminated, has profoundly modified the design of buildings and has reduced to almost a negligible degree the dependence upon natural light.

With the perfection of mechanical apparatus for supplying sweet, clean, washed and humidified air to any part of the building, and with the mechanical methods of exhausting vitiated air, the problem of the architect has been greatly altered, so that to-day large rooms and floor areas can be successfully lighted and ventilated without regard to their local environment; as exemplified in the best types of the modern auditorium, in the commodious basements of the large department stores of the best class, and in the underground rooms of large metropolitan hotels devoted to restaurants, kitchens, etc.

In another chapter of this book, the evil effects upon the structure of the eyeball, due to the concentration of the vision of young children upon the printed page, is touched upon and this fact should be brought home to the educational authorities in such a way that the daylight illumination of school-rooms and the effects of reflection from the side-walls will be more carefully considered, and the best methods employed to conserve the eyesight, than is at present possible under the existing rules. The eyesight of children and teachers during school careers deteriorates rapidly, because of the great injury that frequently results from the improper lighting of the school-rooms.

School-rooms must be illuminated in such a way as to exclude all the effects of glare. The problem of glare has been investigated and the maximum hygienic value for illuminants has been found to be approximately two and one-half candles for each square inch of illuminated surface; that is, no source of illumination, either direct or indirect, should exceed this value of two and one-half candles per square inch of space. It must also be remembered that the impression of glare upon the eyes from the source of light depends very greatly upon the background against which it is seen. A glowing illuminant without a shade, or an incandescent mantel or filament without a protector seen against dark velvet, will be very much more trying to the eyes than will the same source of light with a white paper behind it. All these evils of glare, however, can be overcome by the substitution of indirect lighting on the ceilings of such school and other rooms.

The intensity, amount and distribution of artificial light and its effect upon the color values of rooms and their contents, have been studied according to scientific methods and the results of these studies are available for the student, so that a mere reference to them in this paper must be sufficient.

Natural Lighting.—In the design of buildings, we all know, of course, that architectural design in tropical countries has led to the use of large wall spaces and small window openings, while in the high latitudes the converse is true, and architectural forms have been developed in which the glass surface occupies a large proportion of the wall surface, as exemplified in the Tudor and Elizabethan types, but these influences have not yet seriously affected commercial architectural design, excepting in several classes of buildings, notably factory and school buildings.

In the construction of factory buildings, the recognition of the desirability and necessity for an abundance of daylight has fortunately been rendered easy of accomplishment by fundamental changes in the structural design of buildings, and by the invention of what is known as steel sash. In the design of such buildings, the substitution of structural framework of steel or reinforced concrete for masonry walls and piers, has rendered easily possible, the utilization of large areas of external walls for window openings, which were formerly required for structural support, and as a result of the utilization of these two agencies, the external walls of factory buildings to-day consist of from fifty to ninety per cent. of glass, and of these two agencies, the steel sash has probably done more toward this desirable end than the latent possibilities of skeleton construction alone.

In the design of school buildings, the usual modern requirement that the window area shall not be less than twenty per cent. of the floor area has markedly affected the architectural treatment of such educational buildings, and the further requirement of unilateral lighting, which is gradually being insisted upon as the only correct method of lighting school-rooms, is having a salutary effect also in the design of such buildings. In some States, the educational authorities permit light at both the sides and rear of the room, in entire disregard of the detrimental effect of such a method of lighting on the eyes of the teacher, who is compelled to work facing the light. It is to be hoped that the requirements for lighting all school-rooms will soon insist upon unilateral lighting alone. It should be understood, of course, that this requirement for unilateral lighting does not prohibit skylighting in the ceiling where conditions render this desirable form of lighting possible. The lighting of school-rooms has not yet been given the attention that its importance demands (Fig. 45).

In fixing the ratio of window area to floor space in school buildings, the State Boards of Education should take into consideration the exposure of the windows, for the value of the light admitted to the room is determined,

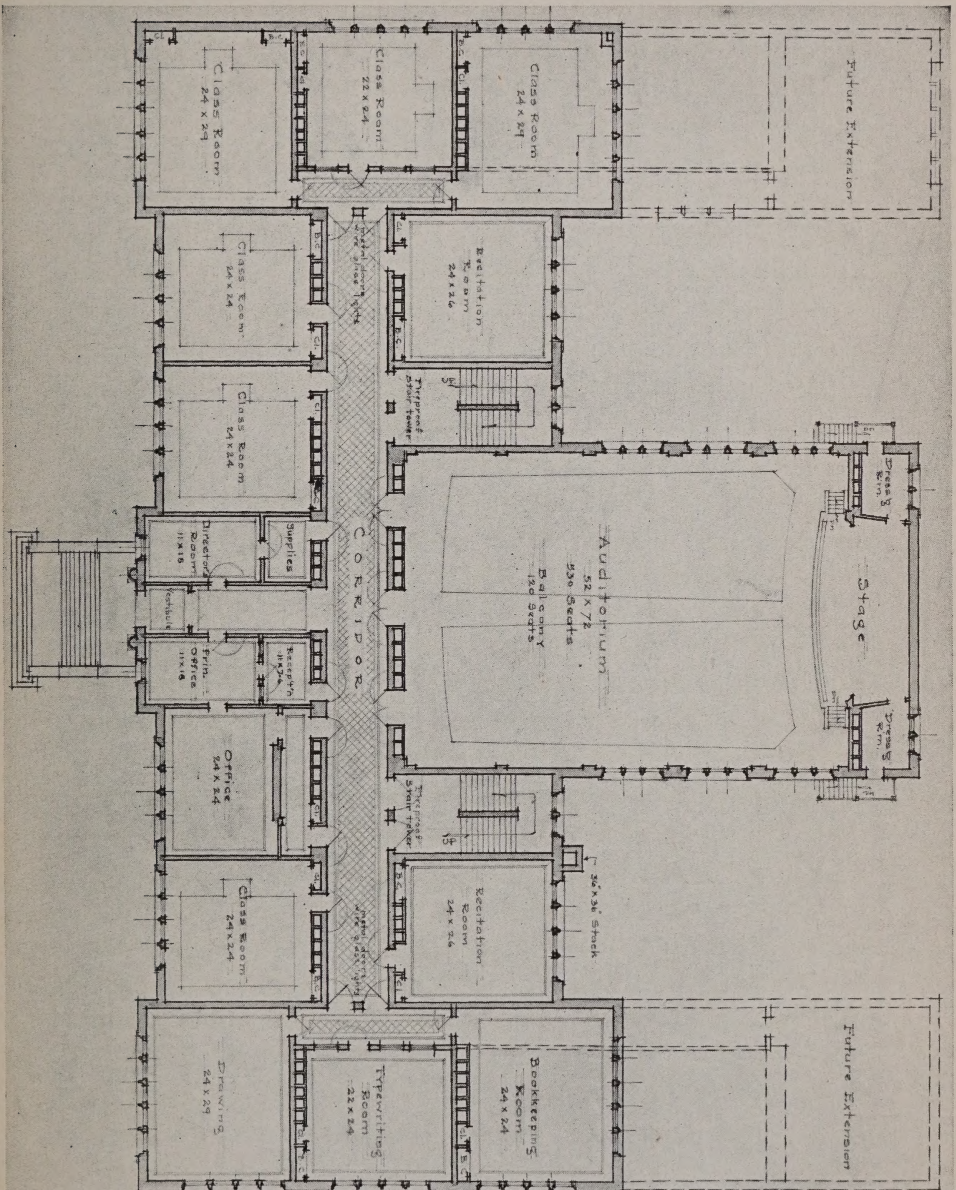

FIG. 45.—Proposed high school building.

of course, very largely by the character of the environment. In city streets with high buildings adjacent, the amount of light admitted to the school-room is necessarily very much less than in the open country where there is no obstruction to the light from the sky. The orientation of the rooms also is not usually considered. In fixing the ratio of window areas, it should also be remembered that rooms with a southerly exposure necessarily receive more light than those with a northerly exposure, and there is no proper excuse for a failure to recognize this important difference in prescribing the requirements for the lighting of such buildings. If a twenty per cent. ratio was needed on the south side, considerable more is needed on the north side, and over and beyond the requirements for daylight, the hygienic value of sunlight should be given due recognition, which would result in penalizing northern exposures. If the State Boards of Education favored the southern exposure in some such way, more consideration would be given to the selection of school sites than is now ordinarily the case. While north light is to be preferred for many occupations where sunlight is not permissible, this consideration does not apply to school-rooms. In many instances, however, the local environment does not permit the admission of a sufficient amount of light, under which condition a resort to a mechanical means for overcoming this deficiency is necessary, and prismatic glass can be used.

The great value of prismatic glass in the lighting of school-rooms has not yet received proper recognition from the educational authorities who prescribe the requirements for school buildings, or has its value yet been recognized by many owners of factory buildings, workrooms, etc. The prismatic glass is simply window glass cast with horizontal prisms on the outer surface, which reflects the light

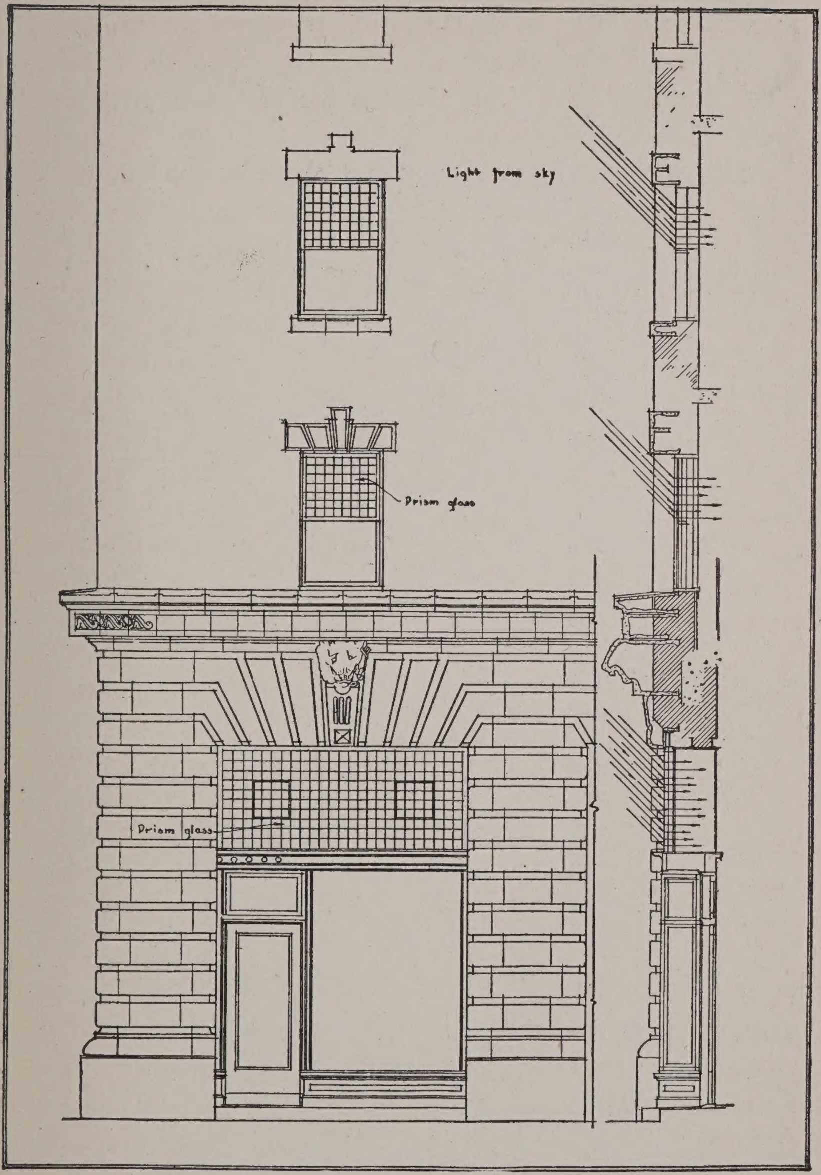

Fig. 46.—Showing the use of prism glass to deflect the light in a horizontal direction.

from the sky into the building. These prisms can be cast at various angles, which throw the light in a particular direction, depending upon the angle of its reflecting surface to the sky (Figs. 46 and 47).

The prismatic glass is made with prisms set at different angles, so that by the proper employment of glass with differing angles, the light can be thrown to almost any section of the upper part of the room. Prismatic glass has the great advantage of being able to make available a light from the sky, which is not possible without its use, and it has a particular advantage in buildings which do not

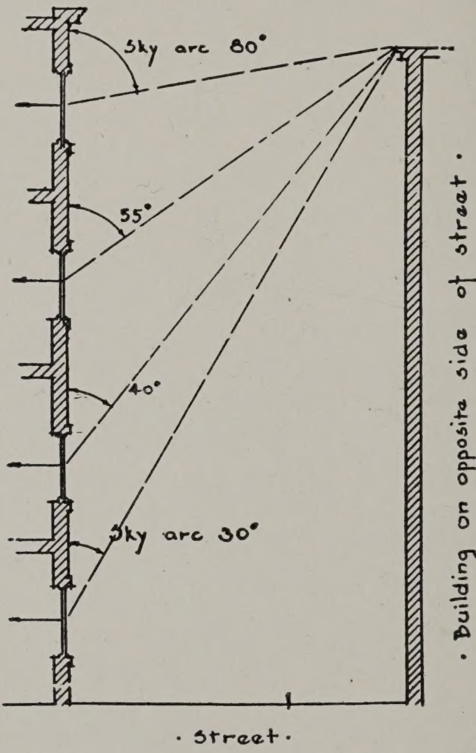

Fig. 47.—Illustrating the uses of prism glass with different angles of reflection.

receive their light from points near the horizon. If school windows with northern exposures were required to have the upper part of the sash filled with prismatic glass, it would go far towards overcoming the disadvantage of this orientation.

What is true of school buildings is also true of manufacturing buildings, although in certain lines of work where shadows are inadmissible and where the intensity of the light should not vary greatly during the working hours, southern exposures are not permissible. In textile trades in the matching of color values, in engraving, in artists' studios, etc., and in all work where close vision is required, the northern light is to be preferred, and where conditions permit, this form of lighting can be accomplished by means of saw-tooth skylights, in which the vertical glass surface of the skylight is only open to the light from the north.

In many buildings where north light is not required, the employment of skylights which have either a glass deck or a solid deck with glass side lights, permits a more equitable lighting of such rooms than can be obtained by windows alone. Such methods of lighting have utilitarian as well as architectural and æsthetic values. The simulation of skylights in the ceiling of rooms, by means of artificial lights placed behind the diffusing sash, has been successfully carried out in a number of rooms, such as auditoriums, restaurants, etc., where the structural conditions prohibited the employment of actual skylights. By this means it is quite possible to give an underground room all the appearance and atmosphere it would have, were its roof opening to the sky. The Auditorium of the Associated Engineering Society's Building, and the Orangery of the Hotel Astor, in New York, are excellent examples of this method of artificial skylighting.

A considerable amount of direct light from the sky in top floors of buildings is not utilized, owing to a prevalent idea that a skylight cannot be made watertight. It is quite possible to make any skylight that is properly constructed and designed as tight as a solid roof, and a knowledge of this fact should lead to a larger use of skylights than is now the custom. There is no light equal to daylight, and every legitimate means of extending its use indoors should be utilized.

Another method of introducing natural light into dark interiors is by the employment of prismatic vault lights set in the surface of pavements. With glass reflecting prisms properly placed, it is quite possible to reflect a considerable amount of light from the sky to the ceilings of basement rooms.

Proper illumination, both natural and artificial, has a distinct commercial value on the output of work. In the first report of the Departmental Committee on " Lighting in Factories and Workshops," recently published in London, some startling facts have been shown. For instance, in testing the strength of the illumination in a workshop on a well-lighted top floor, they found it was only 2 to 10 per cent. of the direct sunshine. In other words, workers, in what would ordinarily be considered favorable conditions, were losing 90 to 98 per cent. of the light. No wonder that eye-strain and headaches are common among indoor workers. It has been found, as a matter of fact, that spectacles are much more commonly used among them than among outdoor workers. Much can be done by the improvements in the system of lighting. In one case, the Committee found, on investigating a workshop where a better system of lighting had been installed, that the production had increased 10 per cent.

# CHAPTER IX

## DISEASES OF THE CONJUNCTIVA

In the chapter dealing with the anatomy of the eye, the conjunctiva was described as the delicate membrane which lined the lids and covered the exposed portion of the eyeball, and was continuous, through the medium of the lachrymal passages, with a similar membrane in the nose. This membrane contains many glands, rich in mucus, and a plentiful supply of blood-vessels and nerves. When the lids are closed, it forms a closed sac, and at all times offers a favorable soil for the growth and development of microorganisms, the germs of disease. These microörganisms are very minute vegetable organisms, which multiply with great rapidity when they are placed under conditions favorable to their growth, and in the process of growing, destroy the tissues in which they develop.

In the case of the conjunctiva, they excite a secretion which varies in character according to the intensity of the inflammation occasioned by the bacillus or microörganism, the product of the most virulent being a thick yellow discharge termed pus, while the milder growths occasion a thick mucoid or catarrhal exudation. The discharges from the conjunctiva excited by these small agents are all contagious, that is to say, they have the power of exciting a similar inflammation in other eyes with which they may come in contact. The degree of the contagiousness is in direct ratio with the virulence of the organism, being greatest in purulent conjunctivitis and least in the catarrhal forms. The term *conjunctivitis* is applied to all forms of inflammations of the conjunctiva, the particular varieties being designated by a descriptive prefix, such as catarrhal conjunctivitis, purulent conjunctivitis, etc.

Infection of the eyes of an individual from those of another is occasioned by the conveyance of the germs, either by bringing them from the affected eye into direct contact with the unaffected eye through the medium of soiled fingers or articles contaminated by the discharge from the the former, or through the medium of the air, the wind blowing the dried secretion from diseased into healthy eyes. The former mode of infection obtains in the purulent form, the latter in the milder or catarrhal forms. This peculiarity of the manner of distribution of the disease accounts for the epidemic form which is frequently observed in connection with the catarrhal forms of conjunctivitis, while the more virulent types, unless propagated under unusually bad hygienic conditions such as sometimes obtain in trachoma cases, generally occur singly.

Not all forms of conjunctivitis are dependent upon germ activity. Uncorrected error of refraction is a potent cause of a mild form of conjunctivitis, the inflammation in the mucous membrane resisting all local treatment until the proper correcting lenses have been prescribed. Simple catarrhal conditions may also accompany inflammation of surrounding structures and may be excited by the action of irritants, such as small foreign bodies, the exposure of the eyes to high winds, smoke, certain fumes and gases, and heat and light rays. Workers over furnaces in iron foundries frequently have injected conjunctivæ, and exposure to the sun rays or snow fields may excite a most distressing conjunctivitis, unless the eyes be properly corrected by some form of protecting glasses, containing lenses properly colored to neutralize the irritating effect of the ultra-violet rays. Greenish and amber tinted lenses have been found to be best for this purpose. The conjunctiva may also be inflamed in consequence of certain diseases of the general system, which germinate poisonous products which may eliminate themselves from the broad expanse of the conjunctival mucous membrane.

Diseases of the conjunctiva, therefore, are among the most common affecting the eye, and occur under a variety of forms. It would be apart from the purpose of this book to describe all, though a detailed account must be given of several, as they are of paramount importance, and their danger and frequency demand a fuller knowledge of them by the laity.

PURULENT CONJUNCTIVITIS OF INFANTS—OPHTHALMIA NEONATORUM.—Under these names are included all inflammatory conditions of the conjunctiva of the newborn babe, conditions which by reason of their malignancy are responsible for at least 25 per cent. of the blindness throughout the world. As it will presently appear that this disease is almost always preventable and its frequency due to ignorance and incompetency, which can only be combated by a campaign of instruction, the consideration of this subject will be treated at length, not only as regards its recognition and prevention, but also as to its treatment.

This inflammation of the conjunctiva appears usually on or before the fifth day after birth, as a redness and swelling of the lids, and with an attendant discharge of watery fluid from between the lids. The redness and swelling of the lids rapidly increase and the discharge becomes thicker and more copious, so that on the third or fourth day after the appearance of the inflammation the lids are so swollen that they can be forced apart only with difficulty, while the lids and the eyeball are covered with a thick creamy pus (Fig. 48). If untreated, the intensity of the inflammation irritates the cornea and this membrane loses its transparency and becomes infiltrated with pus. After a time, the cornea, weakened by its ulceration, perforates, and the fluids within the eye and often the lens escape into the conjunctival sac and the eye is lost (Fig. 49). Although but one eye is usually affected primarily, unless the greatest care is exercised the other soon becomes similarly involved. After the disease has run an acute course of several weeks, the inflammatory symptoms gradually subside, and after a time the lids are opened again, but over sightless and hideous stumps, instead of seeing eyes (Fig. 50). As years go by, not infrequently, the sightless globes stretch and the transparency of the cornea being

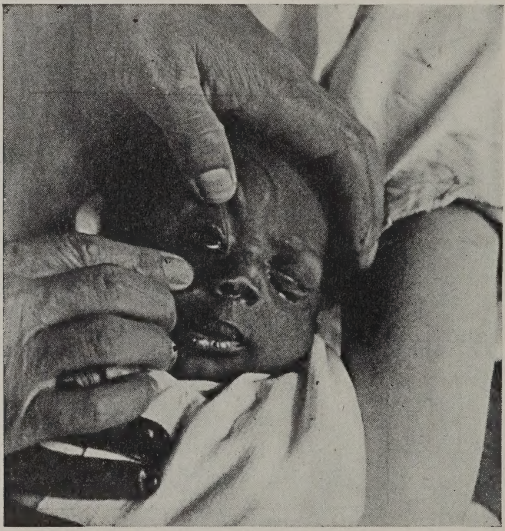

Fig. 48.—Negro baby with ophthalmia neonatorum.

replaced by glistening white scar tissue, the deformed and sightless orbs, rotated by their poor little possessors from side to side in their search for vision, form as striking and distressing a picture as may be found in nature.

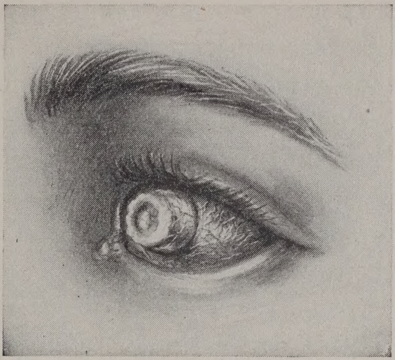

FIG. 49.—Corneal abscess with perforation.

The disease is very contagious, and if the discharge enter the eyes of an adult or older child, an inflammation of even greater seriousness is excited than that which primarily affected the eyes of the new-born babe.

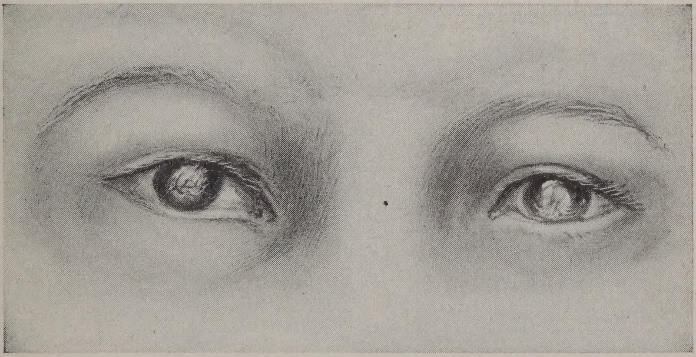

FIG. 50.—Opaque cornea after ophthalmia neonatorum.

The cause of this distressing disease is the infection of the eyes of the child during the passage of the head through the birth canal of an infected mother, or by the entrance of the germs into the eyes shortly after birth, in consequence of carelessness upon the part of attending physician, midwife, or nurse. The germ usually responsible is the pus of gonorrhœa, a disease which affects the genital organs of both men and women, and is readily transmissible from the one to the other. The history obtainable in many cases is that of the mother infected by her husband, who, though once diseased with gonorrhœa, had dared to marry, as the absence of urethral discharge had encouraged the idea that the affection was cured or had worn itself out. After marriage, the disease communicated to the wife in a mild form gives no indication of its existence until the child is born and the germs entering the closed sac of the conjunctiva propagate and destroy. Society should demand that every man who has suffered from gonorrhœa should debar himself from matrimony until he has been assured by expert examination that he is free from infection.

Not all cases of inflamed eyes after birth, however, are due to venereal diseases, for germs of a totally different and less virulent nature may gain access to the conjunctiva and may occasion much the same symptoms as have been described.[1] It is most unfair, therefore, to attach an opprobrium to the parents of all children with ophthalmia, and the finger of scorn has been shaken too often in the face of a perfectly innocent and virtuous father.

As it is sometimes difficult to discriminate rapidly and easily between the milder and, so to speak, innocent type and the malignant form, it is customary to treat all cases from the beginning as though they were of venereal origin, for so rapid and virulent is the course of the conjunctivitis that unless proper and prompt treatment is applied, the eye is lost. No time can be wasted. No chances run.

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[1] It has been estimated that gonococcus infection gives rise to about 60 per cent. of all cases of ophthalmia neonatorum. The pneumococcus is responsible for about 10 per cent.

In 1881, Credé, a well-known Belgian physician, found that if a 2 per cent. solution of nitrate of silver be dropped into the eye of a child directly after birth, the pus germ producing ophthalmia neonatorum could be killed and the development of the disease prevented. This discovery has been of vital importance, and many a child has been saved from blindness by this simple procedure. Statistics show, for example, that in certain classes of cases the disease developed in 10 per cent. of children in whom the silver solution had not been used, and in but 0.17 per cent. after Credé's procedure had been applied.

To eradicate the disease, it would appear therefore only necessary that the silver solution should be used in the eyes of all babies directly after birth. This apparently simple problem is not, however, so easy of solution, and there are various factors which experience has shown must be taken into consideration before urging the adoption of Credé's method in all cases. In the first place, the silver solution, even when properly applied, may excite considerable irritation of the mucous membrane of the eye, which, unless treated, might result in some permanent danger to what might otherwise have been an unaffected eye. Again, the hands instilling the drops may be clumsy or unclean, and healthy eyes ruined in consequence. Many ophthalmologists, therefore, who have cared for eyes damaged in this way, are loath to urge the passage of laws making the application of the Credé method obligatory in all cases, and incline to the recommendation of its use in all suspected cases and in all hospitals and institutions where the danger of infection is greater than in certain classes of private work. Yet it is very necessary that each State should have stringent laws and a well-defined and practical policy aiming at the control and actual elimination of ophthalmia neonatorum. Briefly outlined this should be as follows: 1. Every birth should be reported to the Bureau of Health within 24 hours. 2. Every case of inflamed eyes should be reported to the Bureau of Health within 4 hours. 3. The provision by the Bureau of Health for skilled ophthalmic treatment of every reported case within two hours after the Bureau has been notified of the existence of the ocular disease, by the attending obstetrician or midwife. The bureau must exercise control over the treatment of the case until the ophthalmologist in attendance reports the eyes entirely free from inflammation. When proper home treatment is for any reason undesirable or impossible, all the hospitals receiving financial aid from the commonwealth must be ready to provide indoor treatment for the child and mother as well if the need arise. 4. Solutions of silver nitrate for prevention should be distributed free upon request, and printed matter describing the dangers of ophthalmia neonatorum, with hints as to cleanliness itself, properly couched for the comprehension of the laity and printed in various languages, should be freely circulated. 5. The midwives who have charge of perhaps nearly one-half of the births in the United States should be licensed, and their recognition given only after they have received sufficient education to warrant their attendance of a woman in labor. They should receive thorough training in the washing out of a child's eyes and the instillation of the silver solution (Figs. 51, 52, and 53).

The following directions to mothers, midwives, and nurses are freely distributed by the Department of Health of one of the great commonwealths of this country, and are so clearly expressed and graphic that they are printed in full.

FIG. 51.—A good midwife cares for the baby's eyes. Careless and untrained midwives are responsible for much infantile blindness.

"This disease is always due to an infection entering the eyes of the baby at the time of or shortly after birth. It may be prevented almost always by proper care and early and correct treatment.

"If precautions are not taken, and the disease develops and runs its course unchecked, the sight is totally destroyed, often within a fortnight.

"For All Mothers.—*Measures to be Taken by the Mother During Pregnancy.*—All women during pregnancy should be instructed as follows: Daily external cleansing should be thoroughly performed with soap and water and a clean wash cloth. Should the pregnant woman

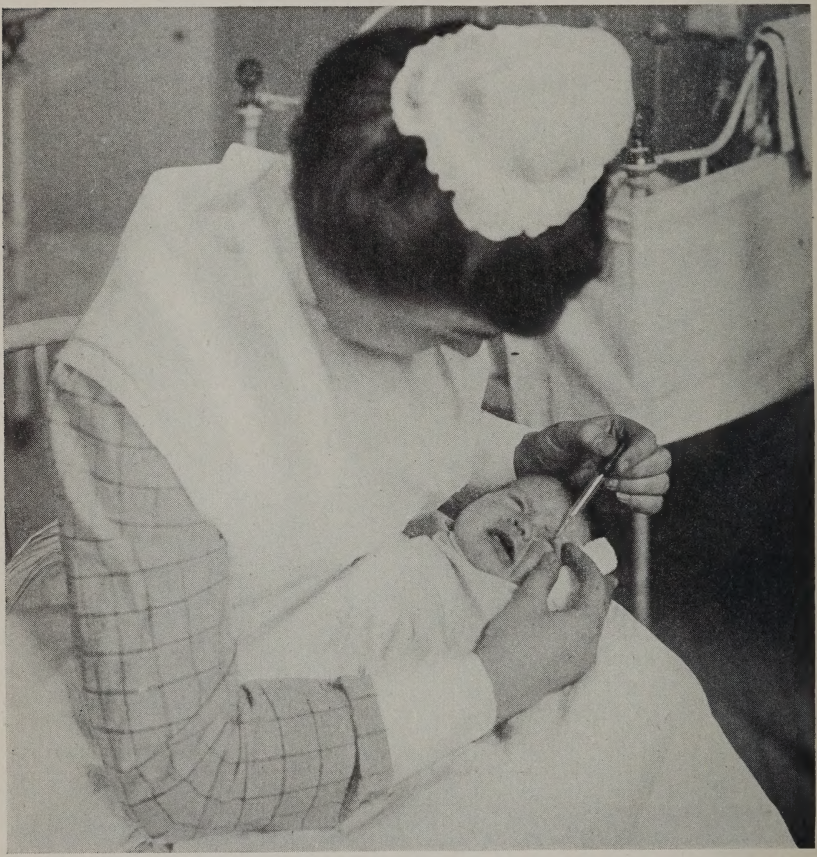

Fig. 52.—Nurse applying drops to baby's eyes.

have any irritating discharges, or even profuse white discharge, she should be instructed to immediately consult her physician or the nearest dispensary.

"FOR ALL CHILDREN (PREVENTION).—*Care that Should be Given to the Child at Birth to Prevent Ophthalmia Neonatorum.*—Immediately after the delivery of the head, before the delivery of the body, the eyelids should be carefully cleaned by means of absorbent cotton or a soft linen cloth and dipped into warm water that has been boiled or boric acid (saturated) solution. A separate cloth

FIG. 53.—New-born baby being treated in hospital for babies' sore eyes.

should be used for each eye, and the lids washed, from the nose outward, free from all mucus, blood or meconium. All wipes should be burned after using. No opening of the lids should be attempted. At this time also the lips and nose should be in like manner wiped free of mucus, and the little finger, wrapped with a piece of moist linen, should be passed into the child's mouth and any accumulated mucus removed by an outward sweep of the finger. As soon after birth as possible the eyelids should be again wiped clean of mucus, and two drops of a 1 per cent. solution of nitrate of silver should be dropped into each eye. One application only of the silver solution should be made, and ordinarily no further attention should be given the eyes for several hours.

" Each time that the child is bathed, the eyes should be first wiped clean, as above described, with the boric acid solution. The hands of the person charged with the care of the child must be washed with soap and dried with a clean towel before the eyes of the child are touched. Everything that is brought near the eyes of the child must be, in every instance, absolutely clean.

" The cotton that is used on the eyes of the child must, in every instance, be immediately burned after it is used. The water, towels, old linen, and the cotton that have been used on the mother must, under no circumstances, be applied to the child. The air of the bedroom must be kept as pure as possible, and the linen should never be dried in the sick room.

" *What Must be Done When Inflammation of the Eyes Appears.*—When the lids become red and swollen, and are gummed along their borders, and when mattery discharge is mixed with the tears as the child sleeps or cries an oculist or a physician should be called immediately, or the child taken to the nearest dispensary. Each hour of delay adds to the danger. While waiting bathe the eyes of the child every half hour with pledgets of cotton dipped in a solution of boric acid. Open the lids wide and allow the solution, which should be warm, to flood the eyes and wash out any matter which may have gathered there.

"The child should not be fondled and nothing which has been used about the eyes or face should be used for any other purpose. All of those in the home should be warned of the danger of catching the disease by getting the matter into their own eyes. Do not listen to those who say it will amount to nothing, or to those who say to bathe the eyes of the child with the mother's milk (the milk is a means of spreading the germs of this disease). Such advice is bad; the delay may result in blindness."

The prognosis in ophthalmia neonatorum depends entirely upon the progress which the disease has attained when the eyes come under the care of the ophthalmologist, for if the proper treatment be instituted within the first few days, before corneal involvement has occurred, the sight can, as a rule, be saved. If the cornea shows signs of ulceration when expert medical supervision is sought, the outlook is much more serious and more or less loss of visual acuity is sure to follow.

PURULENT CONJUNCTIVITIS OF ADULTS.—Gonorrhœa may also affect the eyes of adults, the pus germ being conveyed to the eyes, as a rule, directly from the affected genitalia by soiled fingers. Others may also be infected by the germs being carried to their eyes by towels, handkerchiefs, bed linen, already contaminated by a person with gonorrhœa. The inflammation set up in the conjunctiva under such conditions is most intense, giving rise to great swelling of the lids and of the mucous membrane. In consequence of the intensity of the inflammation, the cornea is involved, and perforation of this membrane, with loss of the eye, may occur within four or five days after the initial symptoms have manifested themselves. If but one eye is affected, the other usually follows unless the greatest care is exercised and the most vigorous treatment instituted.

All attempts to successfully treat such cases as ambulants are futile, and the author cannot remember to have seen one eye saved, unless the patient was confined to bed from the very first and received constant and skilful treatment until the danger had passed.

The discharge from the conjunctiva, at first merely streaked with mucus, becomes thick and copious and is extremely contagious. Attendants upon such cases must exercise the greatest care to avoid infection. All cotton or lint dressings should be burned and the hands of surgeons and nurses carefully sterilized after each application of drugs or dressings. If but one eye is affected, it is usually customary to protect the sound eye by means of a watch crystal plastered into position before the eye by adhesive plaster. This device serves not only as a protection, but also enables the surgeon to inspect the eye and permits the patient to have some view of his surroundings.

So acute is the inflammation and so virulent its progress that it has been estimated that but 50 per cent. of eyes so infected recover. The necessity of prompt and active treatment in gonorrhœal ophthalmia of adults must therefore be apparent, and the strictest mandate to all those affected with gonorrhœa to observe the greatest caution in all things and to seek medical aid on the first suspicion of an inflamed eye seems reasonable to comply with.

METASTATIC GONORRHŒAL OPHTHALMIA.—In addition to the direct invasion of the conjunctiva by means of soiled fingers, etc., the gonorrhœal poison may also enter the eye indirectly, through the medium of the blood. Gonorrhœa does not always remain a localized disease of the genital organs, but in certain cases, especially those who are gouty or rheumatic, and those who have suffered from repeated attacks of the disease, the germs may enter the blood and involve other parts of the body. The joints especially show a marked predilection to participate in this form of general blood poisoning, and under the form of a general rheumatic infection, inflammatory conditions arise in them which are most persistent and frequently cripple the patient for life.

Either as a part of this rheumatic process or participating in a general blood infection without articular involvement, the eye tissues not rarely show involvement; the iris, conjunctiva and cornea may all be inflamed, with a frequency of involvement of these tissues in the order named.

These transmitted or " metastatic " inflammations, as they are called, are extremely serious when the iris is involved, but less so in their corneal and conjunctival manifestations. Metastatic gonorrhœal conjunctivitis is much less dangerous to sight than the conjunctivitis caused by direct infection of the gonorrhœa germ. It usually takes the form of a persistent attack of inflammation of the membrane, with considerable swelling of the lids and conjunctiva and with a more or less copious mucopurulent discharge. Local treatment is ineffective, the inflammation yielding only after the poisonous nature of the internal secretion and the blood have been improved, and by treatment directed to the primary source of the inflammation.

Women are rarely affected by metastatic gonorrhœa, but a form of purulent conjunctivitis is sometimes observed in young girls the subjects of vaginitis, the gonococci present in the discharge being conveyed to the eyes by the fingers or from soiled linen, etc. The resultant conjunctivitis is often quite violent, though rarely so severe as the gonorrhœal conjunctivitis of adults. At times, in consequence of the contagious nature of the vaginitis, the genital affection in association with the conjunctivitis may assume an epidemic form in hospitals, schools and asylums. If properly treated, such cases usually recover without impairment of vision.

TRACHOMA—GRANULAR CONJUNCTIVITIS.—Next in importance to purulent conjunctivitis caused by the germ of gonorrhœa is *granular conjunctivitis,* or, as it is generally termed, *trachoma.* This disease of the conjunctiva runs a prolonged course, affecting all parts of the mucous membrane, and is attended by the development of so-called granulations, or trachoma bodies, in consequence of which the conjunctiva loses its smooth surface and becomes roughened (trachoma, from the Greek "traxus," meaning rough) (Fig. 54). Later the granulations disintegrate and form scar tissue, causing distortion of the lids and lashes. In addition to the changes in the lids, vascularization and ulceration of the cornea follow, giving rise to marked impairment of vision and in some cases to total loss of sight. In most cases the disease is ushered in with symptoms similar to those of purulent conjunctivitis, the lids being swollen and inflamed and bathed in a copious discharge containing an admixture of mucus and pus (Fig. 55). This acute stage may last for weeks or months, finally passing into a milder one of constant irritation and discharge. In other cases the advent of the disease is insidious (Figs. 56 and 57), the trachoma bodies developing with but little accompanying inflammation of the conjunctiva. The lids, however, are thickened and droop, giving a characteristic sleepy appearance to eyes so affected. Upon the eversion of the lids in many of these less acute

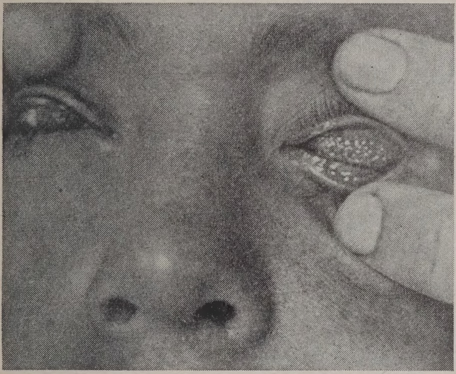

FIG. 54.—A typical case of advanced trachoma showing numerous granulations. Lids hypertrophied.

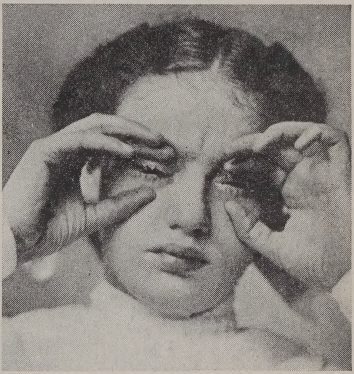

FIG. 55.—Kentucky girl suffering from trachoma, holding her eyes open with forefinger and thumb.

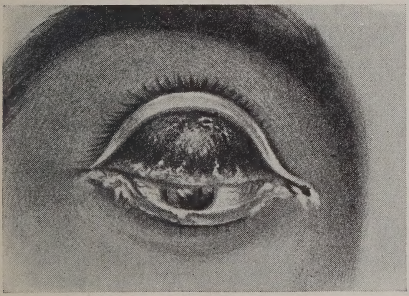

FIG. 56.—Trachoma. Cicatrization well marked.

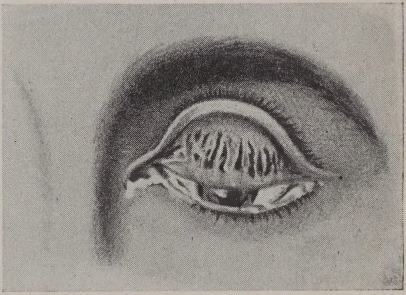

FIG. 57.—Trachoma. Cicatrization almost complete.

cases, the granulations may at first escape the attention of the observer, being hidden deep under the fold of conjunctiva of the upper lid. The course of the disease is essentially a chronic one, remissions and exacerbations being excited by the slightest extraneous causes, as well as by certain conditions of the system. Unless recognized in its earliest stages and a cure assured by treatment (Fig. 58) directed over a long period, trachoma is uncurable, and all of the later forms of treatment are merely palliative.

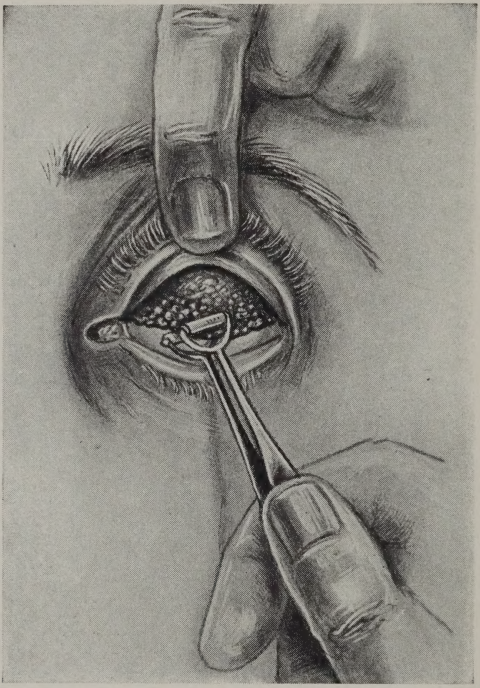

FIG. 58.—The operation of rolling or expression.

Trachoma is an ancient disease, reference to it being found in the earliest literature. Originating in the Far

East, it was probably carried westward along the great caravan routes. Although doubtless present in Europe before that time, the spread of the disease over that country is generally attributed to the return of the Napoleonic soldiers from Egypt to Europe, many of the troops having contracted the disease in Egypt from the native population.

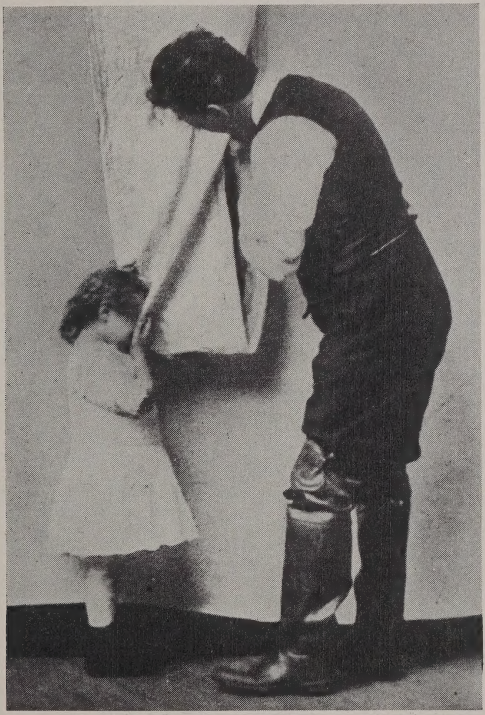

FIG. 59.—Man and child using common towel. Trachoma and other infectious eye diseases contracted in this way.

Trachoma is very contagious, the infective material contained in the discharge being conveyed from eye to eye by dirty fingers, soiled towels (Fig. 59) and linen, and wash basins contaminated with the disease, etc. Trachoma is a disease of poverty, the conditions under which the very poor live fostering its development and spread. The massing together of large numbers of people, children or adults, in badly ventilated houses, without the possibility of maintaining personal cleanliness, is responsible for its rapid spread under such conditions. Hence it is that the Jews, by reason of their abject condition in so many parts of the world, but particularly in Russia and Poland, are so frequently affected. The disease is also common in Ireland and almost all the Southern European nations. It is estimated that 90 per cent. of the population of Egypt is afflicted with the disease. It would appear that the negro race is practically immune from trachoma.

Unfortunately, the disease is not uncommon in the United States, having been introduced largely by infected immigrants. Indeed, in 1897, the government found the spread of the disease from this source to be so great that a law was passed requiring the examination of the eyes of all immigrants and making mandatory the deportation of aliens so afflicted. Unfortunately, however, the bars were put up too late, for the disease had already gained considerable headway in certain parts of the country. The Jewish peddler and tailor and the Italian and Slavish laborer in mines and mills spread the disease, so that there is no part of the country where trachoma cannot be found. The greater number of cases from foreign infection are found, however, in the large maritime and manufacturing and mining sections.

In addition to its spread among the foreign population, trachoma is also common among the American Indians and the Appalachian Highlanders in the mountain sections of Kentucky, Virginia, and West Virginia. There is evidence that the Indians and these mountaineers must have contracted the disease many years ago; just how, will doubtless always remain undetermined. Statistics show that of the 323,000 Indians in our own country fully 20 per cent., or nearly 65,000, are infected. In Kentucky there are 33,000 cases.

One of the greatest problems connected with trachoma is its occurrence and spread among the school children of our country. The children of infected foreigners attend the same schools as the children of the native population, and come in intimate contact with them in studies and games, handling the same objects, and, with shame be it said, using at times the same roller towel, one of the most dangerous methods of transmission of this as well as other diseases.

In view of these facts, it is apparent that in addition to the suffering wrought by trachoma, the visual impairment resulting from it presents a problem of great economic significance. Many are blinded in consequence and become an absolute drag upon the State, while the earning capacity of others affected with the disease is at least one-fourth of that of ordinary individuals.

The government has done much in recent years to abate the evil, for, in addition to the stringent examination of immigrants and the exclusion of all affected with trachoma, the Public Health Service has been active in its efforts to eradicate the disease among the Indians and is aiding some of the States in their campaign against it. Already five completely equipped trachoma hospitals have been erected in the heart of the most seriously infected regions in Kentucky.

The prevention of trachoma, however, demands a more thorough knowledge by the public of its nature and danger, and an improvement in the industrial and housing conditions of the poor. The report of every case to the proper health authorities must be mandatory, and each State must provide proper facilities for the isolation and treatment of all infected individuals until the danger of contagion is past. The eyes of all school children must be examined by properly trained individuals periodically, and arrangement should be made for the inspection of the eyes of all groups of adults, in whom there is likelihood of the existence of trachoma.

The problem of controlling the disease among children is best met by their isolation in hospital schools, until they are absolutely cured of the disease. In order that this may be accomplished, a year or more in residence is often necessary, so that it is desirable to add to their ocular treatment instruction in elemental educational subjects, so that the period of their confinement for medical treatment may entail no period of mental inactivity. The care of adults affected with trachoma is much more difficult of solution, for it is manifestly impossible to isolate the heads of families, their sources of support, for any considerable time. In establishments employing large numbers of workmen, it is often possible to group all trachoma subjects together and to keep them under constant medical supervision, but in factories and mines employing fewer men this is not feasible, and the makeshift of medical care while the disease is absolutely disabling and the continuance of work after the ocular condition has been improved under social service or some other form of supervision, must be adopted. Placards of a warning and instructive nature concerning the danger of the disease and the best means of avoiding it should be hung in conspicuous places, and friendly advice and counsel given to the workers in their own language by some trustworthy and interested person. The following is an example of what such placards should contain:

" *How to Avoid Contracting Trachoma.*—Keep in good physical condition.

Have large windows in your homes, which will admit plenty of fresh air and sunshine.

Sleep with your windows open, even in winter, and keep the room well aired where you live and study.

Wash your face and hands several times a day and keep the finger-nails clean.

Never touch your face with your hands, unless they are absolutely clean.

Do not use the family towel, especially in homes where there are cases of trachoma.

Have your own towel and handkerchief, and don't let any one else use them.

Boil your handkerchiefs before adding them to the wash.

Do not allow your clothing or bedclothes to become soiled with the discharges (pus) from your eyes.

When your eyes are discharging pus collect the discharges on cloths which can be burned, and stay away from other members of your family as much as possible.

Always make sure that the wash basin is clean before using it.

Do not sleep with persons having sore eyes, nor use bedclothes that have been used by them.

Do not wear the clothing of others, nor use their eating utensils without previously cleaning.

Advise any one with sore eyes to have them treated at once.

If the eyes become inflamed, apply at once for treatment to the nearest hospital, dispensary or to your own physician.

Follow the directions of the doctors and nurses as to treatment and prevention."

Although trachoma in its advanced stages is easy of detection, the determination of its existence in the earliest stages is often difficult and can only be made by physicians who have received special ophthalmic training. A number of diseases of the conjunctiva may be mistaken for it, and as these are harmless, the insistence upon the rigorous quarantine just mentioned would entail unnecessary and unjust hardship upon the individuals whose eyes are so affected. The disease of the conjunctiva with which trachoma is usually confused is follicular conjunctivitis, for in this disease the conjunctiva is similarly studded with numerous granules or follicles. This condition, which occurs for the most part in underfed and so-called " scrofulous " children, may persist for months, without giving rise to any secretion from the conjunctiva or corneal involvement. It frequently disappears without leaving a trace under better hygienic conditions, and at no time in its course does it possess any contagious qualities.

It is apparent, therefore, that the examination of eyes for the detection of trachoma, whether it be under the auspices of the government in its inspection of immigrants, or of school authorities, is valueless unless made by thoroughly trained medical graduates. All other examinations are misleading and valueless.[2]

MILDER FORMS OF CONJUNCTIVITIS.—*Acute Catarrhal Conjunctivitis; Pink Eye.*—This form of conjunctivitis, occurring usually in the spring and autumn, when the weather is changeable and the winds high, is the most common variety of conjunctivitis in the United States. It is very contagious, the contagion-bearer, the Koch-Weeks bacillus, the specific organism which causes the disease, being contained in the copious discharge from the conjunctiva, and communicated to the eyes of others not affected in the manner described in connection with the two preceding conditions. The inflammation, which at first occasions but a slight redness of the lids and eyeball, and an increase in the flow of tears, attains considerable severity by the third day, the lids becoming markedly swollen and the discharge thick and ropy. If but one eye is originally affected, the other soon follows. Ordinarily the inflammation runs its course in about 10 to 14 days, the eyes making a complete recovery. Corneal ulceration occurs at times, however, so that the disease demands constant oversight and intelligent treatment. One of the synonyms of the disease, viz., *epidemic conjunctival catarrh,* illustrates a pronounced tendency of the disease, the inflammation frequently spreading to all members of a household. Epidemics of the disease are of not rare occurrence in schools, asylums and similar institutions.

*Subacute Conjunctivitis.*—As indicated by the name, the inflammation in this form of conjunctivitis rarely assumes the activity of that observed in the foregoing, but, unless properly treated, often runs a protracted course. The inflammation shows a predilection for the inner and outer angles of the lids, in consequence of which the term *angular conjunctivitis* is often applied to it. The secretion is usually scanty and has a tendency to accumulate and adhere to the inner angle of the eye. At times, however, the discharge is copious and may assume a mucopurulent type. Corneal ulcerations may also arise, threatening the loss of the eye. The disease may occur at any season of the year, and both eyes are generally affected. This form of conjunctivitis has been found to be due to a definite organism, which was isolated and described by Morax and Axenfeld, two distinguished foreign ophthalmologists.

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[2] For a more detailed account of trachoma from a popular standpoint, the reader is referred to the excellent monograph on trachoma, published by the National Committee for the Prevention of Blindness, 130 East 22nd St., New York.

*Other forms of conjunctivitis due to other germs, such as the pneumococcus and influenza bacillus,* are also commonly met with. While the simpler forms of conjunctivitis may often be cured by the removal of the cause and the repeated cleansing of the eyes by boracic acid solutions and the application of cold compresses, those due to specific organisms demand skilled treatment. The milder forms of conjunctivitis, though ordinarily benign processes of the mucous membrane, may lead to the loss of the eye by corneal ulceration. Furthermore, the recognition of the microörganism causing the disease, and the application of the proper treatment, will often so modify its course that complete relief may be obtained in a few days from symptoms which might often be disabling for weeks. A few applications of a solution containing zinc, to a conjunctiva inflamed by the Morax-Axenfeld bacillus, will often alleviate as though by magic an inflammation which had resisted all other forms of treatment for a very long time.

PINGUECULA AND PTERYGIUM.—By pinguecula is denoted a small yellowish elevation which forms on the eyeball in the free space between the lids and the inner margin of the cornea and the caruncle, a small fleshy structure in the inner corner of the eye. Ordinarily pinguecula is of no significance, beyond the slight cosmetic blemish it entails. At times, however, in persons exposed to the weather and to the irritation of smoke, heat, etc., this little elevation may attain considerable growth, expanding in fan-like fashion to the margin of the cornea externally and to the fold of mucous membrane observable at the inner angle of the eye internally. When it has reached this development, the term *pterygium* (Fig. 60) is assigned to it. Although attached to the cornea and overlapping it, pterygium rarely occasions more than slight visual disturbance by the astigmatism which it evokes. *Pseudopterygium* may, however, develop in consequence of injuries and burns of the cornea, and, when extensive, seriously jeopardize vision by involving that part of the cornea directly over the pupil. Pterygium is amenable to operation, and may be removed by excision or transplantation.

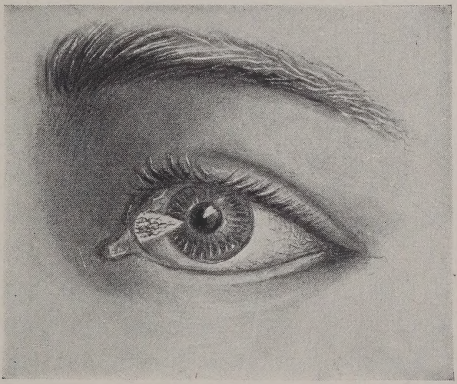

FIG. 60.—Pterygium.

# CHAPTER X

# DISEASES OF THE EYELIDS, LACHRYMAL APPARATUS, CORNEA, IRIS AND VITREOUS

THE outer surface of the eyelids may participate in most of the diseases of the skin affecting the face, such as eczema and erysipelas. The lids may also be the seat of various benign and malignant tumors. Among the former may be mentioned nævi, or blood tumors, of different sizes, and warts. Among the latter, epithelioma, or skin cancer, is the most common. Removal of the benign growths is usually recommended for cosmetic purposes, but as it frequently happens that malignant growths appear at the site of warts and pimples which have been irritated, the early extirpation of all such formations should be advised, with a view to the avoidance of future trouble.

Though the skin cancers affecting the lids grow slowly, their progress is constant, the deeper structures of the lids and sublying tissues being also involved, so that in time the entire structure of the lid is eaten away by the cancer, robbing the eyeball of its protection.

In the early stages, various forms of electricity and radium are very efficacious, but when extensive changes have occurred, excision with the knife, conjoined with the superposition of skin grafts or flaps of skin transposed from the surrounding tissues, is necessitated.

Inflammation of the margin of the lids, or *blepharitis marginitis,* as it is termed, is a common affection, occurring in both children and adults who are in poor health or who are suffering from uncorrected errors of refraction. The condition is essentially chronic and is attended by the formation of crusts and ulcers on the margin of the lids. The hair follicles become involved, and many of the eyelashes are lost, often permanently.

In consequence of the participation of the hair follicles in the process, suppuration of the cavity from which the lashes grow may occur, and a *stye* or *hordeolum* appears. These painful swellings may occasion a very marked œdema of the tissues of the lid, and may give rise to considerable disturbance of the general system before pointing and spontaneous evacuation of their pussy contents. As pus-producing microörganisms are always present, other glands become infected and successive crops appear.

The cure of styes is often therefore difficult. The removal of all predisposing causes must first be essayed. Any tendency to constipation must be overcome by suitable laxatives, digestive disturbances corrected, and tonics administered. In obstinate cases, the hypodermic administration of vaccines is often of value. Locally, the inflammation of the lid margin, often primarily responsible for the development of styes, should be allayed, by thorough removal of all crusts with an alkaline wash and the application of silver nitrate or of a salve composed of varying strengths of the yellow oxide of mercury. The proprietary salves advertised for the cure of styes generally contain this ingredient.

Styes may often be aborted by applying strong solutions of sulphate of zinc to the affected region, or by touching the infected hair follicle with carbolic acid. As contact of either of these substances with the exterior of the eye would be injurious, such applications should be made only by competent medical practitioners. If abortive measures fail, incision with a sharp knife should be made the moment pus forms.

The common practice of poulticing the eye with flaxseed, tea leaves, etc., while giving relief to pain, on account of the heat and moisture they afford, is injurious, on account of the spread of the microörganisms which these factors favor. Should poultices be applied, only those of antiseptic properties, such as bichloride of mercury or witch hazel, should be employed.

Chalazion (Fig. 61).—Another common and often painful affection of the lids results from an enlargement of one or more of the glands which aid in the lubrication of the hair follicles. According to the number of glands implicated, small swellings or *chalazia* form under the skin, which disfigure the contour of the lid, and, often attaining considerable size, press on the eyeball and interfere somewhat with vision. These growths may remain quiescent for months and occasion no symptoms other than those just referred to; in other cases, however, the contents of the glands suppurate, giving rise to pain and considerable irri-

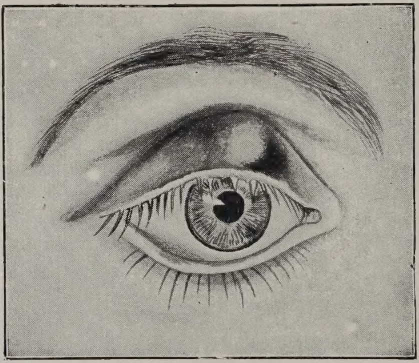

Fig. 61.—Chalazion. (Posey & Wright; Lea & Febiger.)

tation of the conjunctiva. The relief of this condition consists in early incision and evacuation of the contents of the swelling with a small spoon-shaped instrument.

DISPLACEMENT OF THE EYELASHES AND IRREGULARITIES IN THE FORM AND POSITION OF THE EYELIDS.—Frequently after burns and other injuries and long standing disease of the conjunctiva and lids, the symmetry of the row of lashes is interfered with, and the margins of the lids no longer maintain their nice coaptation to the globe, but roll either in or out. These conditions are present in nearly all cases of trachoma, and the irritation of the eyeball by the misplaced lashes, the so-called " wild hairs," is often one of the most distressing features of the disease. Operative measures are usually necessary to correct the evil and a large number of procedures have been devised to restore the normal contour of the lids and to remove the row of lashes from contact with the globe.

PTOSIS.—Another disfiguring lid anomaly is produced by a failure in innervation of the muscles which raise the upper lids, in consequence of which the lids droop and partially cover the eyeballs, imparting a drowsy appearance to the patient, and necessitating the throwing back of the head to obtain clear vision through the partially covered pupils. This condition of *ptosis* (Fig. 62), as it is termed, may occur at any time of life, from paralysis of the nerves supplying the elevators of the lids, or may be present at birth.

Medicinal treatment may remedy the deformity due to paralysis, but some form of operation which unites the lids to the nervous supply of the muscles which raise the brow is necessary for the correction of the congenital variety. Congenital ptosis is often associated with an obliquity of the palpebral fissures and an abnormally broad fold of skin at the base of the nose, imparting a Mongolian type of features to those suffering from this rather uncommon anomaly.

A painful, though fortunately a not very common, affection of the lids consists in the eruption of a number of small blisters over one of the nerves supplying the skin. This affection, designated as *herpes zoster,* is in association with the outbreak of similar vesicles on the skin adjoining the lids, and often on the eyeball. A sharp line of demarcation separates the inflamed area from the uninvolved side of the face. In the event of ocular complications, serious impairment of vision may follow.

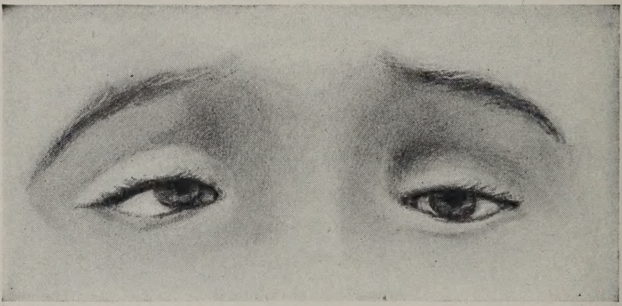

FIG. 62.—Congenital ptosis.

DISEASES OF THE ORBIT.—Injuries to the orbit may cause fracture of its bony walls, and by implication of the optic nerve as it passes through the bony aperture in the apex of the orbit, may lead to sudden and complete blindness. The orbit may be the seat of tumors which cause displacement of the globe and interfere with vision.

On account of the proximity of the large air spaces, or sinuses, which communicate with the nose. the cavity of the orbit not infrequently participates in inflammatory conditions of those structures. Pus in a sinus may give rise to abscesses in the orbit, and the inflammatory process attacking the eye may lead to serious disease of that organ.

Diseases of the Lachrymal Apparatus.—Diseases of the lachrymal gland are rare. Derangements of the excretory portion of the apparatus, however, of the canaliculi, the small apertures situated upon the nasal extremities of both lids, of the sac and of the duct, are very common. In consequence of such disorders, the tears cannot pass from the conjunctival sac into the nose, but flow instead over the lid upon the cheek. This annoying condition may also be occasioned by anything which interferes with the nice coaptation of the lids to the globe, a requisite in the proper conveyance of the tears into the sac.

Injuries of the lids and inflammatory changes in their structures are examples of some of the conditions which alter their position. Annoying lachrymation seems to accompany advancing years, especially in men, upon exposure to wind and cold, due doubtless to an atony of the muscle fibres which surround the sac and aid in the expulsion of its contents. The most common underlying condition, however, is nasal disease, the inflammation mounting from the mucous membrane lining the nasal cavity to that of the duct. Repeated swelling leads to a gradual occlusion of the duct and a damming back of the tears and mucus in the sac. After a time, the sac becomes distended and a perceptible tumor forms just below the inner angle of the eye. If this be pressed by the finger, a quantity of mucilaginous-like matter wells up into the eye, and in cases of long standing, in which inflammatory changes have arisen in the mucous membrane of the sac, a thick creamy pus may often be expressed.

At times the sac becomes the seat of an intense inflammatory reaction (Fig. 63), giving rise to great pain and occasioning marked swelling and redness of the lids and the adjacent skin. Unless there be surgical intervention, an abscess forms, which usually ruptures through the skin over the sac and occasions a permanent fistula.

*Lachrymation* is not always dependent upon improper drainage, but may be of reflex origin, being an accompaniment of almost all diseases of the eye and frequently excited by eye-strain. The physician in his endeavor to relieve excessive tearing always excludes such reflex causes, before directing treatment to the various structures of the lachrymal apparatus.

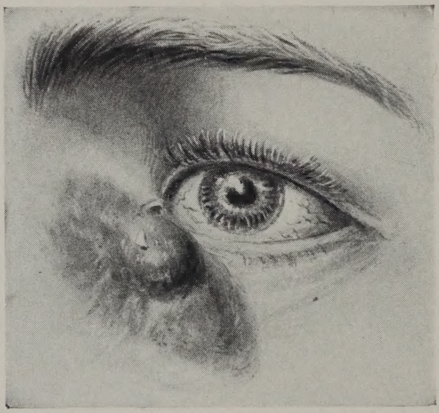

Fig. 63.—Abscess of lachrymal sac, and mucocele.

Diseases of the lachrymal apparatus may be congenital and the persistence of a catarrhal condition of the conjunctiva of one eye should awaken the suspicion of faulty lachrymal drainage.

Formerly, the introduction of probes through the canaliculus, into the nose, to overcome any stricture in the sac or duct was largely practised, but in recent years this painful and often unsatisfactory process has been supplanted by syringing the inflamed lachrymal passages with astringent washes, and when this fails to obtain permanent drainage, by the insertion of a piece of lead wire from the eye into the nose. Such "styles," as they are called, may be worn for years, without occasioning disfigurement or discomfort to the patient.

In purulent cases, the excision of the sac is desirable, an operation of some difficulty, but without danger to the eye or subsequent disfigurement, the resultant scarring being usually imperceptible.

Diseases of the Cornea.—As has been stated in describing the anatomy of the cornea, this structure may be regarded as the window or watch crystal of the eye, its transparency permitting the ready passage of rays of light into the interior of that organ. Should, for any reason, its transparency be interfered with, the passage of the rays is hindered and vision interfered with in proportion to the extent and position of the opacity. If the opacity is peripheral and the pupillary area of the cornea escape, vision may be normal. The slightest haze, however, of the central zone is always attended with more or less impairment of sight.

As the clearness of the cornea would be impaired were it provided with blood-vessels, none are present, the nourishment of the membrane being derived from neighboring structures. Owing to this fact the cornea frequently suffers, in consequence of disease of adjacent organs, also from any devitalizing process in the body which diminishes the circulatory force and nourishing power.

The cornea, furthermore, occupies a very exposed position and is frequently injured by foreign bodies and other forms of traumatism.

It may be judged from the foregoing that disease of the cornea, or *keratitis* as it is designated, is common, and, as a matter of fact, this tiny membrane may exhibit an astounding number of pathological conditions, which tax the experience of even the most trained observer to properly appreciate and catalogue.

Consideration need only be given here of several of the more common affections, with which it seems desirable that the laity should be familiar.

*Phlyctenular Keratitis or Eczema of the Cornea.*—This disease occurs for the most part in scrofulous children, but occasionally in debilitated adults. Children so affected present other signs of scrofula, *i.e.,* a discharging nose, swollen lips, enlarged lymphatic glands and diseases of bones and joints. An eczematous condition of the face and scalp is also frequently present. Many subjects are distinctly tuberculous. The disease often follows the eruptive fevers of children, and occurs usually in warm and moist weather.

The characteristic lesion, the phlyctenule, a collection of cells around a terminal nerve filament of the cornea, disintegrates and forms a small ulcer. Such ulcers may heal, leaving but a slight scar, or, under less favorable conditions, spread both laterally and more deeply into the substance of the cornea, destroying its transparency, and in some cases lead to its perforation, with subsequent escape of the lens and humors within the eye. The enlarged white staring eyes, so frequently observed in those blind from ophthalmia neonatorum and from other destructive types of conjunctivitis, may also be a sequela of corneal ulceration with perforation, and demonstrate how destructive to sight and appearance the involvement of this membrane in an ulcerative process may become.

In consequence of the irritation of the exposed nerve fibrils, the eyes in phlyctenular disease are extremely sensitive to light, thereby occasioning the greatest distress (Fig. 64). The oculist witnesses no more distressing picture than a child with phlyctenular disease, its head buried in its mother's bosom to exclude the light, with tears streaming from the eyes, and with the added discomfort of the eczematous and scrofulous complication just referred to.

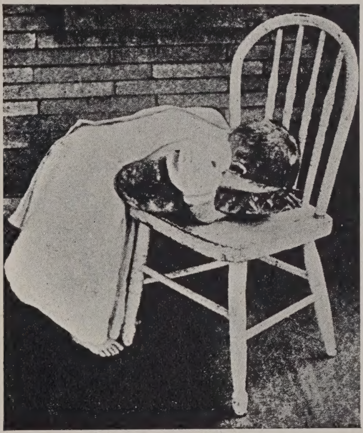

Fig. 64.—Little girl leaning over chair, with head buried in cushion—suffering from corneal ulcers.

It is obvious that the first appearance of corneal haze demands most careful and rigorous local treatment and the best of hygienic and dietetic care to build up the health of the child to nourish the impoverished cornea. It needs but a few days of inactivity as regards treatment to hopelessly destroy or at least seriously impair vision in such cases for life. The folly of resorting to such household remedies as bandaging the eyes with tea leaves, in piercing the ears, as is the custom in some of the southern countries of Europe, in the hope of drawing off the inflammation to another organ, or in securing anything short of the best ophthalmic advice possible, must be evident. In cities, hospitals and dispensaries abound where the poor may receive especial care and treatment, and in the country the average medical practitioner is usually able to cope with such cases. The social service worker is of the greatest service in aiding in the treatment of this class of cases, accompanying the patients to their homes and demonstrating to the household all that is comprised by the term general hygiene. Owing to the protracted nature of many forms of ulcer of the cornea, in cities, especially where it is difficult for the medical advisers to maintain a proper oversight over ambulatory cases, the social worker not only sees that treatment is carried out, but assures the reporting of the patient for clinical oversight and direction at the desired intervals.

Interstitial Keratitis.—The preceding description dealt with an ulcerative inflammation of the cornea which affected primarily the superficial layers. *Interstitial keratitis,* on the other hand, affects the deeper layers, and in most cases is unaccompanied by ulceration, the inflammation being attended with deposits of lymph in the cornea, which do not ordinarily destroy the corneal tissue. Though at times the infiltration of lymph may convert the cornea into a perfectly opaque membrane, this opacity is capable of absorption, and after a variable period the cornea may clear and vision be restored to normal.

In neglected cases, however, the outcome of interstitial keratitis is fully as serious as that of inflammation of the more superficial layers of the cornea, the disease having a marked tendency to spread backward into the interior of the eye and involve the iris, ciliary body and choroid. In consequence of these complications, certain irremedial conditions arise, which cause blindness.

The most common causes of this type of keratitis are syphilis and tuberculosis. Although at times excited by acquired syphilis, congenital syphilis, that variety which is communicated to the offspring by tainted parents, is usually responsible, the disease appearing generally at adolescence, though cases have been observed as early as six years and as late as thirty years of age. In rare cases the disease may originate while the child is still in embryonic form and incurable blindness be present at birth.

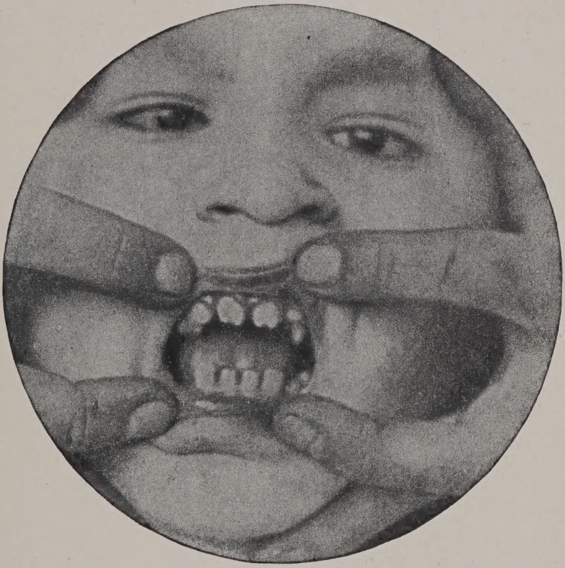
Fig. 65.—Hutchinson's teeth.

Syphilitic subjects of interstitial keratitis usually exhibit other signs of congenital syphilis, the nose being sunken, the skin pale, the knee-joints inflamed, and the face scarred with deep lines radiating from the angles of the eyes, nose, and mouth. A peculiar notching or chisel-shape of the upper permanent incisor teeth is particularly characteristic (Fig. 65). Inquiry will frequently elicit that several " still born " births have preceded the birth of the patient, or that several babies born previously have died in early infancy. The experienced diagnostician can frequently establish a diagnosis in such cases from the history alone without even a glance at the eyes.

Both eyes are usually affected. The first manifestations are a diffuse zone of redness about the cornea, a lack of lustre in this membrane, some dread of light, and excessive lachrymation. After a time, small islets of opacity form in the deeper layers of the cornea. These soon coalesce, increasing the haze of the membrane and preventing access of the rays of light into the interior of the eyes. In an effort to clear the cornea, blood-vessels from the surrounding structures form at the corneal margin.

The symptoms persist for weeks and months, but if promptly and energetically treated, the eyes may recover, with practically normal vision.

Even in the event of recovery, the long suffering entailed by interstitial keratitis and the weakness of the eyes which persists for years afterwards make it a most formidable disease, and offer strong argument against the marriage of those tainted with syphilis. Modern science has evolved tests by means of which the existence of syphilis in individuals may be definitely proven. In view of the tragedies which may follow, it does not seem too much to insist upon the submission of suspected contracting parties to such tests before parental and legal acquiescence to marriage is granted.

Diseases of the Iris.—Diseases of the iris are second to no others in their importance, either in the frequency of their occurrence or in respect to the irreparable damage which may arise from neglect or maltreatment of them. In addition to inflammatory affections, the iris may be the seat of *congenital malformations,* the most important of these being so-called colobomata. These are gaps of variable size, which may extend from the pupillary margin to the periphery and in some cases may be continuous with similar fissures in the ciliary body or choroid. In several interesting cases of this nature reported by the author, the pupil, in consequence of anomalous formations in the iris, was elongated and slit-like, resembling that of the cat. Such anomalies are often hereditary and may be observed in successive generations.

The danger of iritis to the integrity of the eye lies in the tendency the membrane has to adhere to the sublying lens, in consequence of a tenacious exudate which is poured out from the iris in an inflamed state. Such adhesions not only influence the development of cataract by interfering with the nutrition of the lens fibres, but also block the chief avenue of escape of the intra-ocular fluid, as it flows from the posterior to the anterior part of the eye, thereby damming up the fluids within the eye and giving rise to glaucoma. At times the exudate blocks the pupil and hinders the passage of the rays of light into the eye.

Iritis is generally a disease of adult life and occurs much more frequently in men than in women. In addition to the visual disturbances with which it is attended, marked inflammatory symptoms are also present. The pupil becomes contracted and the blood-vessels surrounding the cornea are much congested, though those of the conjunctiva also take part in the congestion. Pain is a constant symptom, usually most aggravated as night approaches. There is no discharge from the conjunctiva, though increased lachrymation is easily excited by exposure to light or any other form of irritation. The interstitial portion of the cornea usually participates in the inflammation, and produces a diffuse haze of that membrane. The ciliary body also rarely escapes and the neighboring portions of the choroid show implication.

The causes of iritis are varied. Some form of constitutional disease or inflammatory focus elsewhere in the body is generally responsible.

Acquired syphilis probably occasions more than half of the cases. The so-called secondary stage of the disease is particularly apt to be complicated by iritis, about the same time as the characteristic rash breaks out upon the skin; more rarely iritis appears in the tertiary period, in which event solid rounded masses or nodules, the so-called gumma of syphilis, appear either in single or multiple form upon the iris.

Articular rheumatism is also accompanied by iritis, this being especially the case when a gonorrhœal element is present. The causal connection between gonorrhœa and iritis is often overlooked in consequence of the long lapse of time which frequently occurs between the appearance of the ocular manifestation and the primary attack of gonorrhœa. The gonorrhœal virus may, however, remain dormant somewhere in the genito-urinary system for years, and though incapable of exciting local irritation in the genitalia may be absorbed by certain membranes of the body, such as the joints and iris. Iritis may, however, occur in rheumatic subjects in whom no trace of gonorrhœa is present, and some of the most intractable cases the author has ever treated have occurred in old ladies suffering from that disabling and deforming type of rheumatism known as rheumatoid arthritis.

Tuberculosis may also play a causal rôle, and this is particularly true in the negro, a race peculiarly susceptible to tubercular infection. Tubercular nodules of the iris are readily distinguishable from the reddish-yellow gumma of syphilis, by their characteristic grayish-white appearance.

Formerly many cases of iritis were imputed to exposure to cold and other extraneous causes. Recent investigation has shown that with the exception of those due to accident, which will be described later, such agencies have but little, if no, influence in precipitating an attack, while inflammatory foci elsewhere in the body, such as decayed teeth, diseased tonsils, inflammation of the surrounding sinuses of the nose, etc., are responsible in many instances.

To the trained observer, the diagnosis of iritis usually presents but few difficulties. Much mischief often arises, however, in consequence of general practitioners and others mistaking the condition for an attack of conjunctivitis, and withholding the proper treatment so long that the adhesions referred to above have had time to become fixed and unyielding. The prompt and complete dilatation of the pupil with atropine or some other drug which acts similarly is essential, in conjunction with the treatment of the sublying constitutional or local source of infection or irritation.

The proper management of iritis should always be relegated to an ophthalmologist, when this is possible, for there is some danger in those not thoroughly trained in the science of ophthalmology supervising the instillation of atropine into the eye. Inflammatory glaucoma often presents a picture not very dissimilar from iritis, and cases have occurred where the practitioner, judging the attack to be iritis, and instilling atropine for its relief, has precipitated blindness by employing a drug which dilated rather than contracted the pupil. Fortunately, the severity of the symptoms following usually leads to the recognition of the error, and prompt operative interference saves the sight, but the damage to vision likely to arise from such mistakes is too great not to warrant every precaution being taken to avoid them.

DISEASES OF THE VITREOUS.—Affections of this humor are always secondary to those of structures surrounding it, and frequently give rise to impairment of vision, by the creation of opacities which vary greatly in size and number. The most common symptom attending vitreous disease is the appearance of motes or muscæ before the eyes, which are treated at length elsewhere (page 182). Near-sightedness of high degree is usually attended with considerable alteration in the structure of the vitreous and becomes a factor in the detachment of the retina which sometimes occurs in this form of eyeball. Injuries of the eye which perforate into the vitreous not infrequently cause the loss of the eye from suppuration, as its structure affords a fertile soil for the growth of virulent forms of micrococci.

# CHAPTER XI

## DISEASES OF THE INTERIOR OF THE EYE; CHOROIDITIS, RETINITIS, OPTIC NEURITIS AND OPTIC ATROPHY

The diseases of the ocular structures which have just been described are all more or less evident to external examination. It is true, as has been stated, that a diagnosis of cataract or glaucoma cannot be substantiated without examining the interior of the eye, but even these two conditions give some external evidence of their existence. Diseases of the interior of the eye, however, demand an ophthalmoscopic examination for their detection, and the possibility afforded by this wonderful instrument of exploring the fundus and studying the changes observed there, is one of the greatest achievements of science.

### Diseases of the Choroid

Like the iris, the choroid may also be the seat of congenital anomalies. The cleft or *coloboma* described in the iris may be continued back into the choroid, or a similar fissure may occur in the choroid alone without participation of the former membrane. This anomaly is explained by some obstacle to the proper closure of the cleft in the eye which is present during intra-uterine life.

A more common condition is *albinism,* or congenital lack of pigment in the choroid and iris. In consequence of this absence of pigment, the iris presents a pinkish appearance, due to the reflection of light from the blood-vessels within the interior of the eye. Albinism is associated with lack of pigment in the hair. Vision is usually much disturbed, both on account of lack of protection from the absence of pigment, and by the presence of high refraction errors. The condition is incurable. Several members of a family are often affected and there is a marked hereditary tendency towards the transmission of the condition.

As stated in a previous chapter, the choroid is the vascular coat of the eye and in close association with the retina. Inflammations of this membrane, which are invariably attended with exudation, almost always cause involvement of the latter, with resultant visual disturbances. Reduction in vision may also result from the haze of the lens and vitreous which may be occasioned by choroiditis.

There are no symptoms of which the patient is conscious which may be said to be characteristic of choroiditis, the diagnosis being made by means of the ophthalmoscope.

The changes observed in the interior of the eye in consequence of choroiditis are, briefly, the presence of exudations, disturbance in the choroidal and retinal pigment with absorption in the later stages, and vitreous haze, if this humor be affected (see Plate II, *D*).

Like diseases of other structures of the eye, choroiditis assumes a multiplicity of forms, a description of which is outside the scope of the present work. Disease of the choroid accompanying myopia has already been referred to.

The chief causes of choroiditis are syphilis, tuberculosis, other infectious processes in the economy, and an extension of inflammatory processes from other ocular structures. Tuberculosis may involve the choroid, either in the form of single or multiple growths. When multiple, they are usually associated with similar deposits in the membranes of the brain and form part of the general symptomatology of tubercular meningitis. Unfortunately, however, their late appearance in the eye, usually but a few hours before death, detracts from their value in substantiating the diagnosis of this, at times, obscure disease of the brain.

At times choroiditis may assume a suppurative character from infection from extraneous causes, or in rarer cases by the transference of purulent emboli or clots from some suppurating focus within the body. The former mode of infection sometimes happens after injury of the eye, the latter in puerperal fever following childbirth. Loss of sight and subsequent shrinking of the eye always follow.

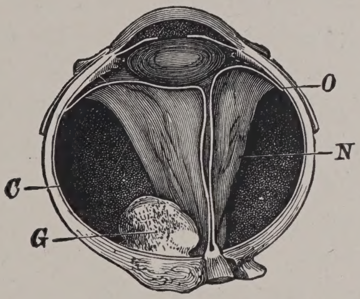

FIG. 66.—Sarcoma of the choroid. (After Leber.) The tumor, *G*, rises from the choroid *C*, which everywhere lies in contact with the sclera. The retina, *N*, on the contrary, is detached entirely from its bed under the form of a folded funnel. It retains its connection only with the papilla behind, and with the choroid along the ora serrata, *O*, in front. (Fuch's Ophthalmology.)

The choroid is the most frequent seat of malignant tumors within the eye (Fig. 66). These may not only destroy the eye, but may also cause death by metastasis or spread to other organs. The most common form of choroidal tumor is the so-called pigmented sarcoma, a variety of cancer which affects the eyes of adults. The growth of this tumor is ordinarily slow and vision may be but little affected for a number of years. It is desirable, however, that such tumors be detected as soon as possible and the eye containing them removed, for early operation is the only means of preventing the spread of the cancer and of saving the patient's life. In some cases, instead of spreading to distant organs, the tumor breaks through the eye and invades the orbit, necessitating the removal of the eye with all the surrounding orbital structures. A local recurrence of the growth in the orbit sometimes occurs after the removal of the eye with the tumor enclosed and without there being any evident invasion of the orbit.

Retinitis.—Diseases of the retina may assume a variety of types, dependent upon their cause. All, however, have certain ophthalmoscopic manifestations in common, namely, haze and swelling of this membrane, exudations, and hemorrhages from the retina vessels, and more or less implication of the optic nerve. The products of inflammatory change within the retina may vary from an almost imperceptibly small hemorrhage to a mass of blood extravasation, and from a minute area of lymph effusion to a saturation and infiltration of the retinal structure which entirely changes its appearance. As retinitis is usually occasioned by some disease of the general system, such as syphilis, tuberculosis or disease of the kidneys and blood-making apparatus, the recognition of the various types of inflammation is of great value to the clinician, and, as has been said elsewhere, frequently leads to the early recognition of diseases whose existence has been unsuspected both by clinician and patient. For a description of retinitis of Bright's disease, and diabetes and of the blood-making apparatus, see pp. 210 and 211. Of no less value are the changes which occur in the retinal vessels, which have been described in another chapter.

In consequence of advanced vascular disease, the main artery of the retina may become obstructed by a clot and sudden blindness ensue. Frequently such attacks of blindness are but transient, vision being regained after a few minutes. After a number of such attacks, blindness usually becomes permanent, indicating that the clot has filled the lumen of the vessels and no more blood can enter the eye. Sudden total blindness in one eye, without preliminary attacks of loss of sight, may at times be occasioned by the lodgement of a clot or embolus, which has been whisked off a diseased valve of the heart, into the central artery of the retina. As a rule, but one eye is affected.

Mild forms of retinitis may be set up by uncorrected errors of refraction and by exposure to intense light.

Retinitis may also occur in both congenital and acquired syphilis, in the latter, as a rule, about a year after the infection has been received.

Of particular interest to laymen, on account of its sociological features, is a rather rare form of retinitis known as *pigmentary degeneration of the retina.* This disease of the retina is associated with a wasting or atrophy of the optic nerve and is characterized by the deposit of peculiarly shaped pigment masses in the substance of the retina, and by hemeralopia or night blindness. This latter symptom, almost characteristic of the disease, evidences itself in a marked reduction of the visual acuity as soon as twilight appears, subjects of the affection who have had but little difficulty finding their way about in daylight being suddenly deprived of this power. In the terminal stages of the disease, vision becomes much affected, and useful vision is usually lost. This form of retinitis occurs in deaf mutes and idiots, but in others also who have no form of disease of the nervous system. The disease is strongly hereditary and consanguinity of the parents of the patient has been discovered so often that there seems to be no doubt as to the influence played by the intermarriage of relations.

In a statistical study made by the author some years ago to determine the frequency of the relationship of consanguinity to blindness in the United States, it was found that the parents were related as cousins in 4.5 per cent. of the cases recorded. Analysis of a large number of cases of this form of retinitis has shown that consanguinity can be traced in about 25 per cent. of the cases. These figures seem sufficient proof of the liability of consanguineous marriages to originate serious ocular disease and demonstrate the desirability for the prohibition of such unions by law and of their discouragement by society.

Retinal Detachment.—The retina under certain conditions may become detached from the choroid and encroach upon the vitreous, in consequence of effusion of blood or lymph beneath its surface.

Upon ophthalmoscopic examination, the retina appears as a floating grayish-white membrane with the retinal vessels running over it. Naturally vision is much restricted, the part of the visual field corresponding to the area of the detachment being lost. This accident occurs chiefly after blows upon the eye and head, near-sighted eyes being especially liable, in consequence of disease of the vitreous. Certain diseases of the choroid and retina which are attended with copious hemorrhage or lymph extravasations may also give rise to the condition. The retina rarely escapes detachment when tumors invade the interior of the globe.

Treatment is usually unsatisfactory, though some cures may be wrought if early treatment is inaugurated. Draining off the fluid from beneath the retina by means of an incision into the sclera, and absorbing the fluid by sweat baths and internal medication, while the patient lies flat upon the back for a period long enough to insure the adhesion of the retina to the sublying choroid, offer the best chances for reëstablishment of vision.

*Tumors of the Retina.*—The most common form of tumor of the retina is a variety of cancer, *glioma,* so called, which occurs not very rarely and for the most part in young children. In the early stages there are no external evidences of the disease, the existence of the growth being usually first detected by the mother upon the appearance of a whitish mass in the pupil.

If the eye with the contained tumor is at once removed, there is some chance that the disease has been eradicated. Unfortunately, however, such cases rarely come to operation until the optic nerve has been implicated, so that, after varying intervals of time, there is either a recurrence of the growth in the orbit, or meningeal symptoms develop, showing that the tumor has invaded the brain. The subsequent course is extremely distressing, the tumor mass in the orbit attaining great size and occasioning marked deformity. Death follows from the invasion of the brain by the cancer.

*Optic Neuritis.*—As has been stated in a previous chapter, the optic nerve is really a portion of the brain, conformed into a nerve-trunk to carry visual impulses from the eye to the brain. Many diseased conditions within the brain are manifest in the nerve, so that the opportunity afforded by the ophthalmoscope of actually viewing and studying the changes which occur in the head of this structure is made use of as a part of routine examinations in all cases of suspected disease of the central nervous system.

The optic nerve, being continuous through the medium of its fibres with the retina, participates in many inflammations of that structure—indeed, it is usually more or less involved in nearly all forms of severe inflammation within the eye. The optic nerve may also be the seat of primary inflammation, and shows a peculiar susceptibility to be affected by a variety of diseases of the general system, such as syphilis, diabetes, and renal disorders, and by the action of certain poisons. It may also be the seat of tumors.

Ordinarily optic neuritis manifests itself ophthalmoscopically by a blurring of the edges of the nerve, in consequence of a swelling and opacification of the nerve fibres as they pass over its edge to spread out over the surrounding retina, and the skilled observer has but little difficulty in arriving at a diagnosis. At times, however, slight degrees of blurring of the nerve edges and nerve fibre opacification may be entirely physiological, and a nice judgment and much experience is demanded to properly judge of the true nature of the condition present.

The most striking changes in the nerve are observable in cases of brain tumor (see Plate II, *F*). Indeed the ophthalmologist is frequently the first to suspect the existence of such a growth, the headaches occasioned by the tumor being attributed by the patient to eye-strain, and ophthalmic aid sought in the expectation that glasses might relieve this symptom. Ordinarily, despite the extreme swelling of the head of the nerve which is discovered at the examination, vision is unaffected, the loss of sight which so constantly attends cerebral growths manifesting itself later.

Frequently such tumors may implicate some of the visual centres and tracts within the brain and one or more of the nerves which supply the ocular muscles, so that the results of the ocular examination are of the greatest importance in the localization of brain growths, often enabling the neurologist and surgeon in attendance to determine with precision the exact site and something of the nature of the intracranial growth.

As the cause of the optic neuritis in such cases has been found to be dependent in large measure upon the increased tension which such growths occasion within the brain, even in cases where localizing symptoms are absent, or in which the removal of the tumor from the brain is impracticable, it has been found desirable to lessen the cerebral pressure by trephining the skull, to avert the blindness which is almost inevitable, in consequence of the damage wrought upon the structure of the nerve. Such procedures are known as decompression operations.

# CHAPTER XII

## SOME VISUAL PERCEPTIONS

THESE may vary from the perception of " sparks " and " motes " to the appearance of figures and objects and even more complicated hallucinations. While frequently but the exponent of some diseased condition within the eye, they are often occasioned by some disturbance transient or otherwise of that portion of the brain which controls the visual acts. Thus, for example, generally speaking, *sparks* or *phosphenes,* as they are designated, are induced by stimulation or irritation of the retina or of the optic nerve and its proliferations into the brain; *motes,* or *muscæ,* as they are called, are occasioned by the perception of imperfections within the eye.

Although the mechanism of the eye is extremely delicate and accurate, its media are far from being uniformly transparent, and it possesses many imperfections, which prevent the functions of the component parts from always being performed with absolute perfection. In addition to a blind spot which is projected in the visual field, somewhat externally to the point of fixation at which the eye may be directed, there are numerous imperfectly transparent parts in all parts of the refracting media. The rays of light in passing through these undergo local absorption and refraction and cast shadows upon the retina. These motes may become evident when one looks directly toward the sky or regards some resplendent and highly illuminated object, as a field of snow, a sheet of white paper, or the field of a microscope.

Were it not for the fact that the great majority of people are unconscious of these imperfections which the eye naturally exhibits as an optical instrument, its efficiency as an organ of vision would be seriously interfered with. Happily, however, they are totally ignored in the vast number of instances, by the habitual inattention which is paid to any indirect visual impression.

The attention of some, whose eyes are particularly sensitive or have become greatly weakened by over-fatigue and other causes, is at times engaged by these bodies, however, and their perception often excites the greatest anxiety and discomfort. Such individuals become the ready prey of charlatans, who add to their fears by the assurance that such motes will lead to speedy blindness unless relieved by their nostrums. These poor dupes are then subjected to years of the severest treatment, only to have their muscæ still undiminished and their minds still burdened with anxiety and fear of approaching blindness.

The presence of these natural or physiological motes is a symptom of no great importance, for they are observed in persons whose eyes are perfectly healthy, but there are *other muscæ which are the expression of some diseased state.* This second variety is occasioned by an opacity of some of the parts of the eye which are usually transparent. The faintest haze of the cornea will throw a shadow, and the slightest impediment to the passage of the rays will distort the retinal pictures. A young lady under the author's care with a diffuse haze of the cornea sees twenty distinct moons whenever she regards that body. In referring to the disturbance of objects occasioned by the formation of a beginning cataract, an ancient authority cites the case of the lamplighter of a castle, who was so startled by the myriad of lights which burst upon his gaze after he had lighted the lamps in the banquet hall before a feast, that he feared a ghostly visitation. This disturbance of images is one of the earliest signs of incipient cataract, and often leads the patient to consult a physician before any appreciable diminution in the vision has occurred.

The most common form of motes is that caused by the presence of *floating bodies in the vitreous humor,* the so-called *muscæ volitantes.* These assume various forms, sometimes resembling spots of various shapes and sizes, as that of a cobweb. More often there is the likeness of an insect, as a spider, worm, or fly. Sometimes they look like streaks or lines, and sometimes they resemble sparks and stars, strings of bright beads, or filamentous bands. Although usually kaleidoscopic, changing their form rapidly and frequently, at times they remain stationary, and a number of people have come under the author's notice who have been conscious of muscæ for twenty years or more, without the slightest change in their number or form.

When they are numerous they interfere greatly with vision and are a source of great annoyance. They move with the eye and appear to descend when the eye is turned upward and *vice versa.* These motes are most commonly seen in myopic eyes, for in this form of eye, the retina being situated more posteriorly, bodies floating in its vitreous project large diffusion circles upon it; but they are also observed in many diseases of the tissues of the eye, and while they may often be of a harmless nature, they may also be indicative of grave change within the eye, and their presence should always be made the occasion for a careful examination.

As has been stated in the opening paragraph of this chapter, visual perceptions of various kinds may be excited by diseases of the brain. Nearly every form of insanity is attended at some time or other by visions of hallucinations, and these appear in an innumerable variety of forms. Epileptic attacks are frequently ushered in by visual sensations. These may be very slight at times, but a passing obscuration, being compared by the patient to the appearance of air that has been heated over a stove. The patient may be annoyed by the presence of a domestic animal, or he may see troops of soldiers passing in review before him. He may be startled by the appearance of a ghostly figure or terrified by the apparition of a bloody spectre.

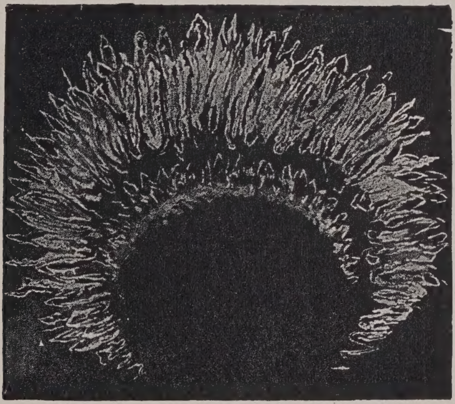

Fig. 67.—Scintillating scotoma in migraine. (Posey & Wright; Courtesy Lea & Febiger.)

These subjective sensations may or may not be colored. They are frequently described as resembling globes of fire of different colors, which possess rotary movements of greater rapidity at the periphery of the globe, but the most common appearance is that which is known as the " fortification spectrum " (Fig. 67). This is the appearance of rays of light resembling darts of fire which form a broken, angular line, of which the edges rapidly vibrate as the spectrum passes across the field. At times, in place of the spectrum, there may be sudden loss of sight. This is never complete, for it involves but half the field of vision. The visual defect may begin at the periphery or at fixation, more usual in the former position.

The one-sided character of the perception is a common characteristic of many visual sensations dependent upon cerebral causes and is a common attendant of that form of headache which is designated as *sick headache, or migraine.* A young man under the care of the author, a clerk in a sugar refinery, accustomed to add double columns of figures, was always made aware of an attack of headache of this nature by the disappearance of some of the figures from the column. This case is somewhat similar to that of a man who was only able to see the letters *son* upon a sign which bore the name of *Jacobson.*

# CHAPTER XIII

## CATARACT

By cataract is meant an opacity of the crystalline lens or its capsule.

In ancient times it was supposed that the loss of sight which could be relieved by the displacement of the lens from behind the pupil was due to an opaque substance which, cataract-like, had poured down over the anterior surface of the lens. This erroneous view held until the early part of the 18th century, when actual dissection discovered that the obstruction offered to the passage of the rays of light into the eye was dependent upon an opacification of the lens itself. Cataract, therefore, is an opacity within the eye, and not, as many laymen suppose, a skin or membrane which forms upon the eyeball itself. There is a popular impression that all opacities or growths which appear on the eyeball are cataracts, forms of corneal opacities and at times conjunctival growths, such as pinguecula and pterygia, being mistaken for them.

Although in its later stages, the opacity of the lens robs the pupil of its blackness and brilliancy and imparts to it a greyish appearance, in its early development cataract is imperceptible to the casual observer.

Cataracts may occur at any age, but are generally observed in infancy or old age. Infants may be born blind in consequence of them and extreme longevity is nearly always associated with more or less haze of the lens. Cataracts are often hereditary and this is particularly true of the congenital variety. The transmission, as a rule, is direct, the skipping of a generation being unusual. Cataracts of childhood rarely affect the entire lens and a degree of vision is usually present. While generally amenable to cure by operation, cataracts associated with various congenital ocular malformations are sometimes inoperable and their possessors must be relegated to the ranks of the blind.

The most common form of cataract is that which occurs in men and women alike in the later years of life and is designated as *senile cataract.* In this class of cases, the lens begins to lose its clearness usually after the 50th year, small more or less isolated opaque areas appearing in various portions of the lens. Fortunately, these opacities are often in the periphery of the lens, and present no obstruction to the passage of the rays of light as they are refracted by the central portion of the lens after leaving the pupil. At times, however, the opacity of the lens occupies the central zone from its very commencement and entails serious impairment of vision when the cataract is still in a very immature stage.

As opacities in the lens are rarely discoverable by simple inspection, their presence is usually manifested by increasing difficulty in seeing, and particularly in seeing near objects clearly. It is a matter of frequent observation that patients may lose much of their keenness of perception for distant objects without being cognizant of it, the loss in vision being detected in an increasing disability in reading. No reading glasses with which they are provided give a satisfactory clearness and the persistence in close work occasions headache, watery eyes and other forms of eye-strain. At times symptoms directly referable to the visual impairment occasioned by the irregular refraction of the rays of light through the partially opaque lens will arise, and images are distorted and the perception of objects will sometimes be reduplicated. A candle-light, for example, may appear double or triple. Exposure to sunlight will dazzle an eye with central lenticular haze, such eyes seeing best when the pupil is dilated in a diminished illumination.

The tendency of most cataracts is to become complete, that is to say, the opacification gradually spreads throughout the structure of the lens until its entire substance has lost its transparency. This transition is rapid in some instances, but in ordinary senile cataracts is extremely slow; indeed, in many instances the opacification remains more or less stationary after its initial development, and the haze being localized in the periphery of the lens, many go through life with such opacities, without any perceptible limitations in vision and unaware of the existence of such a condition. It is for this reason that ophthalmologists are very chary of informing patients of the existence of slight lenticular changes, every ophthalmologist of experience having had numerous examples in his practice where an ill-advised information by others of the existence of cataracts has caused much needless anxiety over a long period of years. The author has in mind a lady approaching 80 years of age, with almost normal vision in each eye, who was told by a foreign oculist nearly 20 years ago that she had cataracts.

Cataract to the lay mind means blindness, sooner or later, and this diagnosis once rendered, it is impossible to completely allay the suspicion of impending danger by any qualifications as to slowness of development, etc. While it is usually wise to inform some member of the patient's family of the discovery of lenticular changes and their possible import, to avoid future misunderstanding and possible recrimination, in most cases a patient should only be told that he has cataract when appreciable diminution of vision is present or imminent.

While the lenses of most people in advanced life are more or less hazy, senile cataracts are not a product of old age alone, and other factors must be present to excite their growth. The influence of heredity has been referred to; various constitutional diseases also have their effect. Among them, diabetes is especially liable to be complicated by lenticular changes, and may cause cataracts at a comparatively early age. Bright's disease and diseases of the vascular system are also responsible in a number of instances, the lens suffering in its nutrition in consequence of alterations wrought in the tissues of the structures nourishing it, by an interference with their circulation.

Workers over furnaces frequently develop cataracts, through exposure of the eyes to the light and heat rays emanating from the glowing coals. Flashes of electric light of great brilliancy from short circuitings have also produced total opacification of the lens. As will appear later, cataracts frequently result from injury. Lenticular opacity accompanies many diseases within the eye and the loss of sight which attends many cases of disease of the choroid and retina is dependent upon this cause.

The conviction is steadily growing among eye surgeons that prolonged eye-strain is responsible for many cataracts, and it is now generally recognized that the decrease in the number of cataracts among city dwellers may be accounted for by the improved conditions under which this part of the community carries on its near work. As a rule, the citizens of towns are provided with better means of illumination than their fellows in the country and are able to avail themselves of the facilities offered by specialists and special hospitals to obtain the proper glasses to correct their refraction errors. Improper glasses can do much to create changes within the eye which manifest themselves as cataracts later.

The diagnosis of cataract is made by means of the ophthalmoscope. By means of this instrument and by focal illumination, the character and nature of the lenticular opacity may be carefully studied and noted, for cataracts may assume a great variety of forms, the recognition of which is of great significance to the surgeon in determining upon the course of treatment applicable to each case.

Generally speaking, the treatment of cataract is considered under two heads, that of *incomplete or immature cataract* and that of *complete or mature cataract.*

When cataract is discovered in its incipient stages, after the careful correction of the refraction by means of proper glasses, the habits of the patient are inquired into and changed if they are found to exert any possible deleterious effect upon the eyes. The hours of close use of the eyes are restricted and caution enjoined regarding their too-prolonged use by artificial light. Frequent interruptions of a half-hour to an hour in the near use of the eyes is advised.

The care of the general health is essential and particular attention given to the condition of the skin, by daily baths and regular exercise in the open air. The patient is encouraged to take daily walks, their distance being dependent upon age and strength.

Smoked glasses are often of service, to prevent dazzling by sunlight. Simple lotions are prescribed, to lessen any conjunctival irritation, also internal medication given to reduce any congestion of the interior of the eye.

Notwithstanding the claims of certain classes of irregular practitioners who advertise their ability to cure and absorb cataracts by certain nostrums and manipulations, no form of treatment has yet been devised whereby this may be accomplished, the improvement in vision thought to be gained by such practices being either imaginary upon the part of the patient, or due to an improved condition of other parts of the eye, the opacification in the lens still remaining the same.

While cataracts cannot be absorbed and hence cannot be said to be cured by treatment other than operative, their development may often be retarded, and every eye surgeon of experience has many patients under his charge who have attained a ripe old age without appreciable impairment of vision. Frequent changing of glasses is often necessary to conform with the alteration in refraction occasioned by changes within the lens, and all patients with cataracts should report for observation once or twice yearly.

In addition to the other forms of medication mentioned above, the author is of the opinion that in some cases the local use of dionine within the eye has some power to lessen further lenticular opacification.

The cure of cataract consists in the removal of the lens by operation. In young subjects while the lens is soft, this is accomplished by introducing a special form of knife needle into the eye, and by cutting the capsule of the lens, permitting the aqueous humor to come in contact with the lens substance (Fig. 68). The effect of this commingling of the two humors is finally to absorb the entire lens structure, the capsule alone remaining. A second needling operation, as it is called, divides this membrane, and the passage of the rays of light is no longer impeded. Children with congenital cataracts may be operated on by this method within a few months after birth, though it is usually desirable to wait until 12 or 18 months of age have been attained.

Cataracts in older subjects are not amenable to this form of treatment, on account of the greater hardness of the lens, and must be removed from the eye by an opening made into the globe through the cornea and extracted by the method indicated in the accompanying illustration (Figs. 69 and 70). The first step in the operation consists in the introduction of a wire frame or speculum to separate the lids and expose the eye. The eyeball being held firmly by a pair of forceps, the cataract knife is entered at the junction of the cornea and sclera, somewhat above the horizontal plane of the eye, and by gentle to and fro movements is made to cut its way out at the upper extremity of the corneal scleral junction. The avenue of

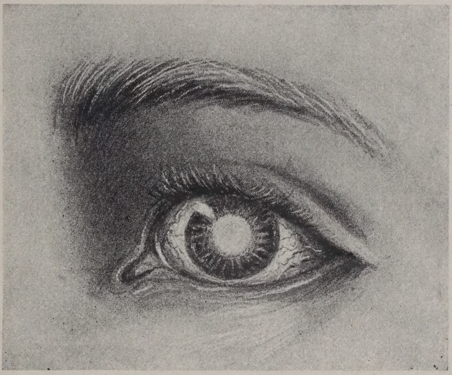

Fig. 68.—Swollen opaque lens after needling.

exit being now prepared, a small piece of the iris is excised to facilitate the expulsion of the lens and to prevent

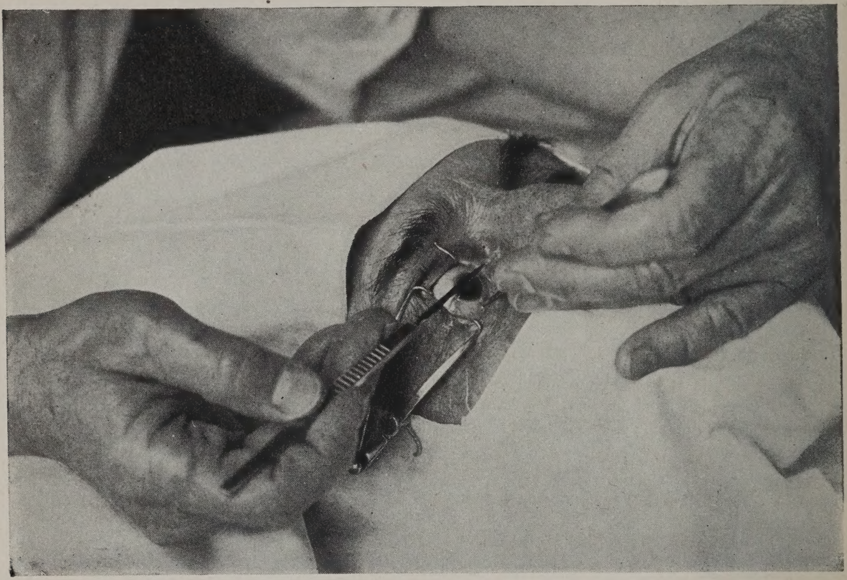

FIG. 69.—Incision of the cornea for the removal of cataract.

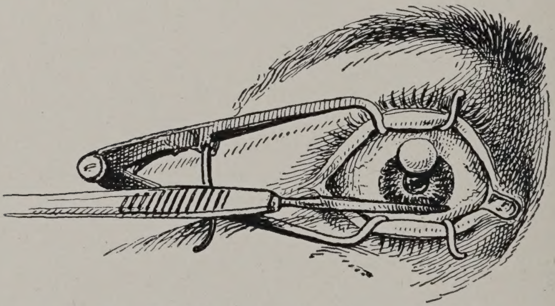

FIG. 70.—Expulsion of lens through corneal incision.

prolapse of this membrane into the wound during the act of healing. Following an incision into the anterior capsule of the lens by a small but exceedingly sharp knife, the lens is cautiously stroked out of the eye by a small spoon-shaped instrument, and after a careful cleansing of the wound to facilitate its proper closure and insure prompt healing, the speculum is removed, the eyeball flushed out with a mild antiseptic lotion and a bandage applied.

This extraction of the lens is usually performed under cocaine anæsthesia, and is practically painless. The operation lasts but a few minutes, though the patient is incapacitated for several weeks, until the healing process is finished. In about half of the cases, a secondary operation is necessary before satisfactory vision is obtained. This consists in introducing a knife needle into the eye and clearing the pupil of remnants of capsule and lens débris which sometimes remain after the primary operation.

If the eye from which the cataract has been removed was practically of normal build, that is to say, emmetropic before the cataract developed, after the removal of the cataractous lens, it is necessary to supply the eye with a focussing power equal in strength to the lens which has been removed. This is accomplished by prescribing a lens to be worn before the eye in spectacles of much the same spherical strength as the crystalline lens. With this lens it is usually necessary to combine a cylindrical lens of moderate strength to correct the astigmatism resulting from the corneal incision.

The cataract operation is successful in the majority of cases, the patient being enabled to read the finest type with the correcting lenses and to see sharply in the distance. The wearing of such powerful lenses as is necessitated after the removal of the lens is attended with some inconvenience, the perception of objects lying outside of the focus of the spectacle lens being naturally much less perfect than is the case in eyes from which the crystalline lens has not been removed. This visual limitation, however, is very slight and should not detract from the proper appreciation and recognition of the great boon which this operation has been to humanity. The restoration of a helpless blind individual to activity, efficiency and happiness is an achievement for which humanity should be ever grateful to the many surgeons of many different races, whose efforts extending over years of trial, led to the development and perfection of the present form of procedure.

The operation is one of exceeding difficulty, and the best results are naturally attained by the most able and experienced. At times, however, even when performed by skilful operators, with the most stringent attention to antisepsis, and with the best of after care, inflammation arises in the operated eye and vision is not restored. In some instances this failure is due to technical difficulties arising during the operation, but in the majority, to some condition of health of the patient, which retards the healing process and favors the development of inflammation in the eye. For this reason the operation is not always a success in those who suffer from Bright's disease, diabetes, tuberculosis, and certain forms of rheumatism, and in alcoholics, though even in such cases perfect results are often obtained, and the existence of such disorders are not deemed a positive contradiction to it.

The careful operator will naturally avoid operating until any ocular complication, such as disease of the tear passages, which might possibly jeopardize the success of the operation, has been removed.

In former years it was deemed unwise to remove a cataract until it was ripe, that is to say, until the entire lens was entirely opaque and the eye quite blind. Later experience and the perfection of methods have determined this restriction to be unnecessary, and the rule adopted by most operators where both lenses are cataractous and blindness threatening, is to remove the cataract most advanced, as soon as the vision in the best eye deteriorates to such a degree that reading is no longer possible or going about unsafe, certain technical procedures recently perfected rendering the removal of unripe cataracts practically as safe as those which are fully matured.

From what has been said, it seems unnecessary to state that a cataract once successfully removed cannot return, it being impossible for the lens to regenerate itself.

# CHAPTER XIV

## GLAUCOMA

THE term glaucoma is used in a broad sense to cover the whole series of morbid changes which are produced by increased fulness or tension within the eye. Under normal conditions, the pressure in the ocular chambers which preserves the shape and tension of the eyeballs is constant, the balance of secretion of the intra-ocular fluid and the amount of blood and lymph within the eye being established by the drainage and escape of these fluids through proper avenues of exit. Should, for any reason, the balance be disturbed and any hindrance offered to the escape of these fluids, either by a stoppage in the drainage canals or by a change in the constitution of the fluids, in consequence of which their filtration powers through these canals is retarded, too much fluid collects within the eye and the eyeball hardens. As will appear presently, the consequence of this increase in tension is most disastrous to sight, the tissues of the eye being unable long to withstand the destructive effect of the pressure exerted upon them.

Glaucoma exists under a variety of forms, which, however, do not differ in their essential nature, but only in the degree and rate of increase of the tension. In what is designated as chronic glaucoma, the pressure increases very slowly, without giving rise to any inflammatory symptoms; in subacute glaucoma the increase of tension comes on in a succession of attacks, which are attended with marked symptoms of congestion of the eyeball and more or less disturbance of vision. In acute fulminating glaucoma, the rise in tension is rapid and maintained and is attended with total blindness in the affected eye.

Glaucoma is further designated as primary or secondary. In the former, the disease arises independently of any other affection within the eye, while in the latter it is dependent upon or, rather, occurs as a sequel to some preexisting ocular disease. Secondary glaucoma needs no further comment here, being of too technical a nature to describe in a work of this kind.

Primary glaucoma is, however, of paramount importance to the layman, and the necessity of an appreciation of its chief characteristics even more important perhaps than that of cataract. Sight may be lost from cataract and may be regained by operation, but the loss of vision from glaucoma is usually incurable, and cannot be regained.

While in the acute forms there are inflammatory symptoms which warn the patient of the existence of disease within the eye, in the more common chronic form such warning symptoms are absent, the patient imagining the slight visual disturbance from which he suffers demands but stronger glasses for its correction. Should an optician be consulted, instead of an oculist, as happens not infrequently, the disease if in its incipiency will be overlooked, a pair of glasses prescribed, and perhaps even a second and a third pair at later intervals, as the loss of sight progresses and the failure of the lens to give requisite vision proves inadequate. If medical aid is then sought, the disease has often progressed so far that but little can be done to check the disease and retain the vision that remains, for the sight which has been once lost from chronic glaucoma cannot be regained.

The warfare waged in so many states by medical men to restrain the activities of opticians and optometrists, has been entirely with the view of protecting the public against such disasters as arise from this prescribing of glasses by those untrained in all the branches of ophthalmic science. The recognition of glaucoma in its early stages demands a high degree of knowledge and training in this branch of medicine, and unless the disease be recognized and treated properly, more or less loss of sight is sure to follow.

If treated early, the cure of the condition may be attained in many cases, and in others the sight saved for many years.

Operative measures will save nearly all cases of the inflammatory forms, provided they are instituted early in the course of the disease. The danger in the inflammatory varieties resides in the failure to obtain prompt operative relief, either in consequence of delay in securing the services of an ophthalmic surgeon, owing to remoteness from medical centres, or to improper treatment administered by some medical man, who has mistaken the glaucomatous attack, on account of the attendant vomiting, for a bilious seizure, or for an inflammatory condition of the conjunctiva or iris.

As has been said, chronic glaucoma in its initial stages presents nothing unusual to a casual inspection. The ophthalmologist will detect, however, an unusual shallowness of the anterior chamber and perhaps a slightly dilated pupil. The ophthalmoscope will also reveal a commencement of depression or cupping of the head of the optic nerve. Physiologically, the hole in the sclera which permits the passage of the optic nerve into the eye is the weakest part of the eye, and is therefore the first to give way when the intra-ocular tension becomes increased. In consequence of the pressure, the head of the optic nerve is pushed back, and a cup-shaped depression formed, vision being seriously compromised by the damage inflicted upon the nerve fibres as they leave the nerve to spread out over the retina.

While in the early stages, those who suffer from glaucoma may not be aware of a visual disturbance other than difficulty in reading, the ophthalmologist is frequently able to map out blind spots and other losses in the visual field.

The tonometer, an instrument devised to record the hardness of the eye, also enables the ophthalmologist to properly estimate the intra-ocular tension and gives positive proof of its elevation.

If untreated, the chronic glaucomatous eye slowly increases in hardness until the rise in tension is even perceptible to the examining finger. The pupil becomes more widely dilated, and the cupping in the head of the nerve deeper and deeper. After varying lengths of time, total blindness ensues, and a greenish hue is imparted to the pupil, whence the disease received its name.

The diagnosis of the inflammatory form of glaucoma presents few difficulties, the sudden rise in tension being attended with signs which are absolutely characteristic to the skilled observer. A deep zone of congestion surrounds the cornea, the pupil is dilated, and unless the haze which soon spreads over the cornea prevents, the cupping of the nerve is demonstrable. In some cases, hemorrhages occur in the retina. Vision is rapidly lowered, and if the affected eye be directed toward a light, on account of the haze of the cornea, circles of various colors are seen about it.

There is usually great pain in the eye, which often radiates into the temple and down the side of the nose, and vomiting is provoked with other signs of severe physical depression. Sight may be entirely lost in a few hours, never to be regained, unless operative measures are instituted. In the subacute variety, a remission in symptoms

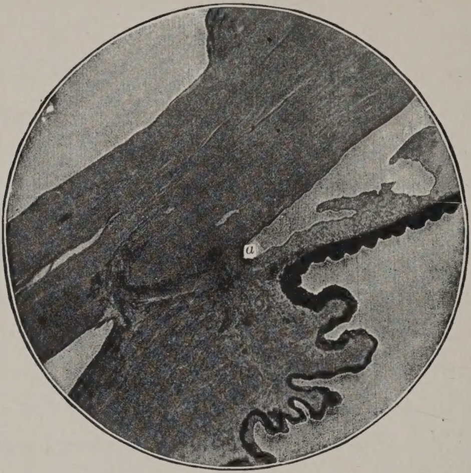

Fig. 71*A*.—Microphotograph of anterior part of a normal eye, showing the main channel of escape for the intra-ocular fluid (*a*), *i.e.*, the angle of the anterior chamber, open. (After Collins in Posey and Wright; Lea & Febiger.)

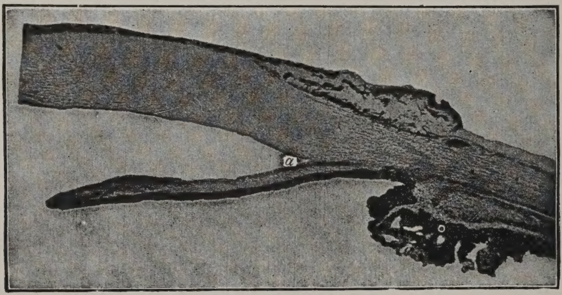

Fig. 71*B*.—Microphotograph of anterior part of a glaucomatous eye, showing this angle (*a*) closed. Iridectomy opens this angle by removal of part of the iris. (After Collins in Posey and Wright; Lea & Febiger.)

usually follows after some hours, in which event the tension falls and the eye slowly regains its normal appearance, vision mayhap being thoroughly restored.

While there is some difference of opinion regarding the best means of conserving vision in chronic glaucoma, it has long been established that some form of operative procedure is demanded, and demanded with as little delay as possible, in all forms of inflammatory glaucoma.

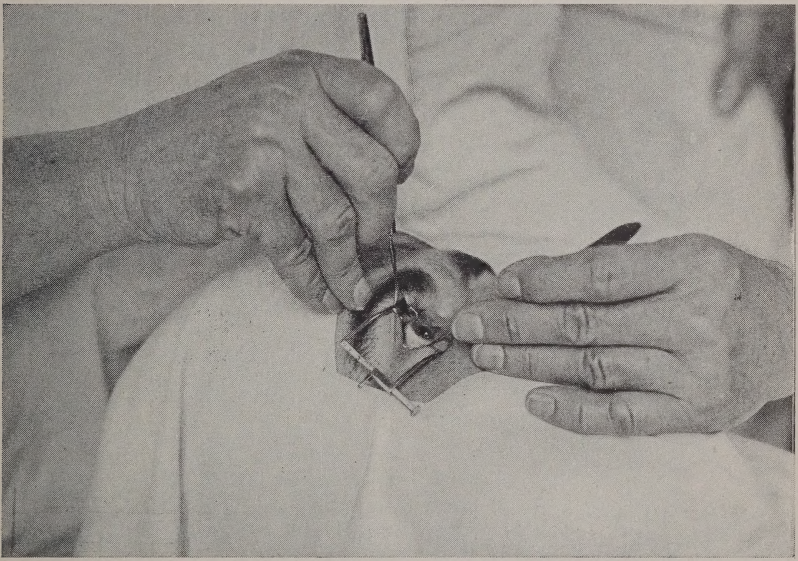

Fig. 72.—Incising the eye at the corneal margin for iridectomy.

The chief avenue of exit of the intra-ocular fluid is through a porous space at the angle of the anterior chamber, where the root of the iris and cornea join. By reason of the rise in tension in glaucoma, this space is blocked, the base of the iris becoming adherent to the neighboring cornea. The aim of operators, therefore, is to open this space, either by removing a section of the iris, or by cutting a hole into the eye in this position, to obtain a permanent area of filtration. Various modifications of these two methods of procedure, of iridectomizing (Figs. 71, 72, 73, and 74) and trephining the eye, as they are called, are in vogue, operators the world over being busily engaged in perfecting methods which will best maintain a porous space through which the fluids may escape from the eye. Naturally, various medicinal measures, both general and local, are also of value.

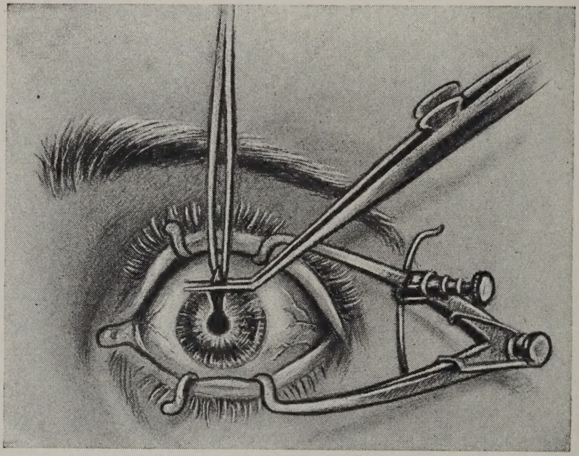

FIG. 73.—Iridectomy; a portion of the iris has been drawn through the cut in the sclera, and excised close to its ciliary attachment by one or more snips of the scissors held parallel to the scleral incision.

The results of these operations are often but short of marvellous, eyes which have been blind for hours, indeed, in some instances for several days, being restored to perfect visualizing organs. The world is indebted to von Graefe, the famous German ophthalmologist, for this boon to humanity, this distinguished surgeon being the first, in 1856, to restore vision in eyes blind from glaucoma by iridectomy. Until von Graefe's discovery, blindness from glaucoma was incurable.

While the results of operation are not so brilliant in chronic glaucoma as in the inflammatory varieties, treatment for this condition is far from hopeless, and vision may be retained in many cases as long as life lasts, either by some one of the forms of operation just mentioned, or by the continuous use of myotics. Myotics are drugs, such as eserine and pilocarpine, which have the property of contracting the pupil and pulling the base of the iris away from the cornea, thereby opening up the filtration angle of the eye. The author has long been an advocate of their use and has reported cases where vision has been maintained for more than 20 years by their continuous employment. As their use necessitates an intelligence and steadfastness which is not possessed by all classes of society, and the more or less constant oversight of an ophthalmologist, this method of treatment is not usually resorted to in all hospital cases. Operation is also reserved for cases in which the use of myotics fails to control the disease.

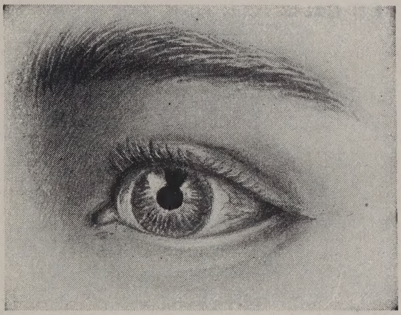

Fig. 74.—Coloboma of iris after iridectomy.

Patients should be enjoined to follow the regimen as to the curtailed use of the eyes, exercise in the open air, etc., already described as applicable to cataract cases. Particular care should be given to the adjustment of the vascular system and the lowering of a too high blood-pressure.

Glaucoma is a disease of middle life, true primary glaucoma being but rarely met with earlier. Its cause has never been accurately determined, though there is good evidence that eyes with lenses relatively too large for the circumlental structures about them are particularly predisposed to the disease. Arterial sclerosis has been thought to exert a causative influence, also gout. Uncorrected eyestrain and the overuse of the eyes by faulty illuminants are factors in some cases. An hereditary tendency can be traced in a number of instances. The Hebrew race is especially liable to be affected.

In concluding this chapter, the author would make an earnest plea for a wider dissemination of knowledge regarding the prevalence and dangers of glaucoma among the laity. Treatment to be efficacious must be early administered, and the likelihood of glaucoma being overlooked in its initial stages, when in the event of failing vision, opticians and optometrists are consulted instead of qualified medical practitioners, must be recognized, and the possibility of danger arising from such examinations thoroughly appreciated.

# CHAPTER XV

# THE PARTICIPATION OF THE EYE IN DISEASES OF THE GENERAL SYSTEM

The eye is part, and a very important part, of the general organism and participates in greater or lesser measure with many, indeed if not all, of the various disorders and diseases which affect the body. By reason of its particularly intimate association with the brain and nervous system, there is scarcely any affection of these structures without ocular implication, indeed the initial symptoms of many of the most important of the morbid processes occur in the eye, and it frequently is the lot of the ophthalmologist to be the first to discover the existence of some serious disease of the brain or spinal cord, which had hitherto been unsuspected, both by the patient and his family physician. A peculiarity in the behavior of the pupil excites the suspicion of locomotor ataxia, and the discovery by the ophthalmologist of a swelling of the optic nerve removes all doubt as to the causation of the headaches from which relief may be sought, and leads to the detection of a tumor of the brain.

The general practitioner judges of the state of the blood-vessels and of the circulatory system of his patient by noticing the condition of the blood-vessels, as it is manifested in the color of the lips and nails, and in the general appearance of the skin. The force and power of the circulation is determined by the pulse, by an examination of the heart, and by instrumental measurement of the blood-pressure. The eye specialist. however, by means of the ophthalmoscope, can look directly into the eye and actually observe the blood-vessels themselves. Since the discovery of this instrument not only has much which was obscure concerning local affections of the eye itself been explained, but great aid has been afforded the general practitioner in his diagnosis of diseases of the general system. The existence of so-called hardening of the blood-vessels, and unsuspected diseases of the kidneys, liver and other organs have frequently been brought to light by its use. The obstetrician may be warned by the ophthalmologist of evidences of the insidious poisoning of pregnancy before other positive signs of this condition are manifest and may inaugurate treatment which will save his patient from the not infrequent fatal accidents of childbirth.

The more skilled and experienced the examiner, the wider will be the revelations and interpretations of his ophthalmoscopic examinations. How erroneous is it, therefore, for individuals to fail to avail themselves of all that such examinations may reveal, when ocular aid is determined upon for the relief of troublesome symptoms. The ability to use the ophthalmoscope understandingly and to interpret its findings properly presupposes a thorough medical training, and a knowledge of the various pathological states of the body is only to be acquired by years of study of diseases of the general system as well as those of the eye. The ophthalmoscopic examinations by others than physicians, therefore, examinations by optometrists, so called, and opticians, can only be superficial, and the interpretations of their discoveries vicarious.

ANÆMIA.—Diseases of the blood generally give rise to changes in the blood-vessels of the retina, and in the retina itself, which are readily observable by the ophthalmoscope. In chlorosis, a form of anæmia observed in young women with menstrual disorders, these changes may be very pronounced and the involvement of the optic nerves and attendant hemorrhages into the retina may seriously compromise vision. The author has recorded several such cases in which only the most rigorous treatment averted blindness.

The insufficient nourishment afforded the ocular muscles in anæmia is at times productive of symptoms of fatigue following the close use of the eyes, and proper tonic treatment must be added to the functional correction of any existing refraction error before relief is obtained. Indeed, in many instances the recognition and treatment of anæmic conditions by hygienic and medical measures will often remove the necessity of prescribing glasses. A certain dryness and congestion of the conjunctiva is observed at times in anæmic individuals, which resists local treatment and only yields after the administration of iron and similar tonics.

The retina participates in the severe implication of the general system which accompanies that rather rare form of disease, *pernicious anœmia;* indeed, the occurrence of retinal hemorrhages in a long-continued anæmia without adequate cause often establishes the diagnosis between a simple and pernicious type of the blood disease. In *leukœmia,* another grave form of anæmia, the ophthalmoscopic changes are very striking and significant, and may first call attention to the existence of the disease.

Simple loss or diminution in the quantity of the blood is very rarely followed by ocular changes, the additional predisposing factor of impoverished blood being seemingly required to bring about changes within the eye. If the loss of blood is dependent upon disease of some organ, such as the stomach or womb, serious disturbance of the optic nerve and retina not infrequently follows, this being especially the case when hemorrhages are repeated. Hemorrhages from the lungs are much less apt to occasion ocular changes than those from the organs just mentioned.

RHACHITIS—RICKETS.—By reason of the impoverishment of the general system, which is a constant concomitant of this disease, ulcers of the cornea and inflammatory conditions of the conjunctiva occasionally arise. The most important change wrought in the tissues of the eye is, however, a peculiar form of opacity of the crystalline lens, which may be either present at birth or arise shortly afterwards. This particular form of opacity is limited and involves the zone of the lens situated between its centre and its circumference and is designated as "zonular" or "lamellar" cataract. Vision is greatly interfered with and the removal of the lens by operation is usually necessary before sufficiently clear vision is obtained to enable the individual to read small type.

DISEASE OF THE BLOOD-VESSELS.—In no other diseased state of the body has the ophthalmoscope afforded such aid in diagnosis as in the detection of changes in the blood-vessels of the retina, and but few general practitioners fail to avail themselves of the opportunity afforded by the ophthalmoscope of actually observing the retinal blood-vessels. It has been estimated by an eminent authority that changes in the retinal vessels occur in nearly half of all patients with general arterial sclerosis.

The importance of the early interpretation of these vascular changes may be impressed more firmly, when it is realized that they are part of the general vascular disease which not infrequently eventuates in chronic kidney disease.

The pulsation in the retinal vessels can be plainly observed by the ophthalmoscope, and certain affections of the heart accompanied by marked changes in the pulse can be readily diagnosed by a glance into the eye.

Cardiac disease may also manifest itself within the eye by the formation of a clot in its principal blood-vessel, with resultant blindness, which is usually fortunately limited to one eye. The occurrence of repeated small hemorrhages in the conjunctiva and retina in individuals on the far side of 65 years is a bad sign for longevity, such occurrences being frequently the precursors of cerebral apoplexy.

Diseases of the Kidneys (Bright's Disease).—The ocular changes excited by kidney disease are of paramount importance and, occurring at times before other symptoms have made themselves manifest, in some cases even before albumin has appeared in the urine, the oculist is frequently the first to discover the existence of this dread malady. By far the greatest number of cases exhibiting retinal changes occur in chronic disease of the kidneys, but the acute inflammations of these organs, which at times accompany scarlet fever and pregnancy, and less frequently those secondary to intermittent fever and chronic lead poisoning, may also evoke them. Both eyes are usually affected. It has been estimated that retinal changes discoverable by ophthalmoscopic examination are found in about 20 per cent. of all cases of chronic disease of the kidneys. The average age at which the retinitis occurs is over 40 years, varying, however, between 5 and 78 years. The far greatest number, however, occur between 40 and 50 years of age.

The retinitis of kidney disease is more or less diagnostic (Plate II, *C*), that is to say, the hemorrhages and extravasations which are found there as part of this general disease assume more or less definite forms, so that the skilled observer is, as a rule, able to determine the existence of the kidney lesion by even a cursory glance into the eye.

Ophthalmoscopic changes accompanying disease of the kidneys have a serious import, as they usually indicate a marked progression of the disease, and indicate that unless the greatest care is exercised, but a few years of life remain. A carefully regulated manner of living, with the best of medical care, may, however, prolong life for many years. The author has in mind the case of a man of advanced years who is still in fair health, in whom albuminuria, retinal changes and other evidences of renal disease have been present for at least eighteen years.

The extent to which vision is affected depends naturally upon the extent and location of the changes within the eye. Total blindness is rare, though vision is usually so seriously compromised that the ability to read fine type is lost.

The loss of vision due to structural change within the eyes must not, however, be confounded with the transient attacks of total blindness which occur in kidney disease and which are of uræmic origin, being dependent not upon changes within the eye, but due to an irritation of the brain centres governing vision by poisonous substances circulating in the blood, the product of the kidney disease.

Transient puffiness of the lids, due to an infiltration of the tissues of the lids, may occur in the early stages of nephritis. Permanent œdema or thickness is a later manifestation of the disease.

**Diabetes.**—In this disease, which is characterized by the occurrence of many obscure symptoms in the nervous system and elsewhere in the organism and by the more or less constant presence of sugar in the urine, the involvement of the eyes is of frequent happening. The ocular manifestations are also varied, for nearly all the tissues of the eye may be affected. The most important, however, are the changes which occur in the ciliary muscle, in the lens and in the retina, for it happens not infrequently that the ophthalmologist is the first to call attention to the existence of diabetes, by the discovery of the more or less characteristic disturbances which the abnormal quantity of sugar in the economy occasions in those structures.

It has been asserted that eye changes manifest themselves at some period during the progress of a case of diabetes in at least two-thirds of all cases. Such manifestations may occur as early as nine years, though the greatest proportion are observed between 60 and 70 years of age.

The changes occasioned by diabetes in the ciliary muscle manifest themselves in disorders of the accommodation, interfering very markedly with reading and all close use of the eyes. Not infrequently, individuals unaware of their having diabetes, consult the ophthalmologist for stronger glasses, on account of a paralysis, more or less constant, in the muscles of accommodation.

Even more significant is the opacification of the crystalline lens which occurs in diabetes, with a frequency variously estimated from 4 to 25 per cent. Unlike haze of the lens or cataract from other causes, apart from the congenital varieties and those which arise from injuries, diabetic cataract may occur at any age, being often seen in subjects as young as ten years. Another point of dissimilarity between this variety of cataract and all other forms of haze of the lens, is its spontaneous disappearance at times, and the influence of proper treatment in lessening its density.

So frequent is the association between diabetes and cataract, that it is a rule of eye surgeons to test the urine of all cases presenting lenticular opacities for sugar. Its discovery, while not contra-indicating the removal of the cataract, for in many instances this may be accomplished without accident, always arouses anxiety in the operator, for at times complications occur which seriously mar the success of the operation.

The retinal manifestations consist in hemorrhages and extravasations which may seriously affect vision. Often however, these yield to treatment and perfect sight is regained.

INFECTIOUS DISEASES.—Although nearly all fevers resulting from infectious processes may exhibit ocular symptoms at some time or other in their course, it is beyond the scope of this volume to detail all such complications. It will suffice to refer briefly to the disorders the eyes are prone to suffer in several of the more common of these conditions.

As is well known, the eye symptoms of *measles* are very marked. In the early stages the dread of light and increased lachrymation often arouse the suspicion of the true nature of the fever, and these symptoms, with the attendant catarrhal inflammation of the conjunctiva and the occurrence of ulcers on the cornea, often continue long after the fever has abated. Unless the eyes receive suitable local treatment and the room is properly darkened, the cornea may become the seat of ulcers, which by occasioning later scar formation or even actual perforation of that membrane, may seriously jeopardize sight throughout the rest of life. Thousands of children have had their lives marred by neglect and injudicious treatment during an attack of measles. All direct sunlight should be shut out of the sick-room as long as fever is present, and only as much reflected light permitted as may be tolerated without pain.

In consequence of the weakness of the ocular structures, all near use of the eyes should be prohibited during convalescence, being resumed only after the general system has thoroughly recovered from the effects of the fever.

If corneal ulceration occur during the course of the treatment, the practitioner in charge should seek the aid of an ophthalmologist at once, and the advice of the specialist should also be sought during convalescence, if any signs of inflammation about the eyes persist during this period.

Too often the close use of the eyes is permitted earlier than is proper, fostering the development of near-sightedness and astigmatism. If errors of refraction are found to be present after convalescence, it may be desirable to correct such errors by glasses, until the eyes have regained full strength.

*Scarlet Fever.*—Like other febrile conditions, scarlet fever may give rise to catarrhal conjunctivitis and marked ulceration of the cornea. As a rule, however, the eyes suffer but little in this disease, though inflammation of the optic nerve and retina may be set up by complicating disease of the kidneys. Not infrequently, eye-strain is complained of during convalescence, and may persist after the general health is reëstablished. The importance of the avoidance of too early use of the eyes and the correction of all errors of refraction by suitable glasses is apparent.

*Diphtheria.*—Apart from a destructive form of conjunctivitis, which sometimes, though rarely, affects the lining membranes of the lids, and certain forms of paralysis of the eye muscles, which are also of infrequent occurrence, the ocular lesion most frequently met with is the partial or complete paralysis of one, or what is more usual, of both ciliary muscles. This paralysis, which totally disables the eyes for all close work, may follow even slight attacks of diphtheria. The paralysis supervenes from 3 to 6 weeks after the appearance of the disease, persists for weeks or months and finally disappears, even in untreated cases. Convex lenses, to supplement the inactive lens, by reason of the paralysis of the muscle controlling it, are necessary for all near work as long as the action of the ciliary muscle is suspended.

*Small-pox.*—Before the days of vaccination, it was estimated that 35 per cent. of all cases of blindness were due to this disease, whereas to-day the proportion ranges from between 2 to 3 per cent. The eruption of small-pox frequently occurs upon the lids, whence it spreads to the cornea, causing ulceration and the production of dense scars, or even perforation of that membrane. So virulent is the poisoning of the system by this noxious disease that almost all of the ocular structures may take part in the general infection, and for the sake of conservation of vision, if for no other reason, society should coöperate with the State in the enforcement of vaccination laws and the compulsory report and segregation of all cases.

Carelessness in vaccinating may result in the accidental vaccination of the lids by fingers soiled with the virus, and the loss of the eye may follow precisely as if the resultant pustule had been part of the general infection.

At times, in children and the weak, a purulent, though mild, inflammation of the cornea and conjunctiva may be excited by an ordinary vaccination, which demands treatment and exclusion of light for some weeks following the inoculation.

*Erysipelas.*—This infection, usually involving the skin of the head, may spread to the lids, causing abscesses and subsequent deformities in these structures, and sometimes ulceration of the cornea. The orbital tissues may also be invaded, giving rise to inflammation of the optic nerve, with resultant blindness or serious impairment of vision. At times the inflammation spreads from the orbit to the brain, and death ensues from meningitis or clot formation.

*Typhoid Fever.*—Fortunately, serious ocular lesions, though sometimes observed in the later stages of the disease, are rare in this not uncommon fever. Corneal ulcers and attacks of conjunctivitis common in all febrile diseases are, however, occasionally observed. More important for consideration in a work of this kind is the relaxation of all the muscles of the eyes which accompanies the long convalescence, and the importance of the avoidance of all ocular strain and the correction of all refraction errors until full health has been regained.

*Malaria.*—More or less typical ulcers of the cornea may complicate malaria, but by far the most important lesions affect the uveal tract, retina and optic nerve.

*Influenza.*—All of the ocular structures may be involved by this bizarre disease, but none are sufficiently constant to render them typical of it. Perhaps the most common are those resulting secondarily from diseases of the adjacent air cavities which are connected with the nose. The neuralgic pain and tenderness of the eye and the parts about the eye are usually dependent upon the involvement of these structures and can be relieved only by appropriate nasal and sinus treatment.

*Whooping-cough.*—Not infrequently, due to the congestion of the ocular tissues by the spasmodic cough and the violence of the effort, the sclera of both eyes may become deeply suffused with blood, occasioning no little alarm to the layman. The hemorrhage, however, is superficial, just below the conjunctiva, and is quite harmless, being totally absorbed in a few weeks.

*Mumps.*—Like all the infectious fevers, mumps may in rare instances give rise to serious inflammation of the optic nerve and retina. Ordinarily, however, the eyes are unaffected. Rarely the lachrymal glands, by an extension of the infective process to other glandular structures, such as is observed more commonly in the testicles, may be affected and pronounced swellings may appear under the outer portion of each orbital ridge.

*Cholera.*—In consequence of the severe emaciation wrought by this now fortunately rare disease, the eyes are frequently seriously involved. The globes sink back into the orbits, and the patient lying semiconscious, with lids but partially closed, dust collects on the devitalized cornea and extreme ulceration follows.

*Leprosy.*—Leprosy, also a rare disease in the United States, has definite ocular symptoms, the leprous nodules forming on the lids and at times on the eyeball. Deformities of the lids and dense opacities of the cornea are frequent sequelæ.

*Tuberculosis.*—It is not remarkable that this widespread and common infective process should have frequent ocular manifestations. The eyes of children are most liable, but the lesions may appear at any age in individuals whose resisting power to the specific organism carrying the disease is weak, as well as those unduly exposed to infection. The most striking ocular lesions occur in the negro, a race whose resisting power to the disease is extremely low. Nearly all the parts of the eye may be affected, but the cornea, iris, and choroid are chiefly liable.

In rare instances, the eye may be the primary seat of tuberculosis. Usually, however, the ocular manifestations are secondary to tuberculosis elsewhere in the system. When seated in the iris, the tuberculous masses present a very characteristic appearance, rising out of the dark tissue of the membrane as small grayish-white cone-shaped masses, resembling small sugar loaves. The discovery of similar though smaller nodules in the choroid, by means of the ophthalmoscope, may establish the diagnosis of tuberculosis in cases of obscure meningitis, though the value of this discovery from a prognostic or therapeutic standpoint is minimized by the fact of their occurrence so late in the disease.

The most common seat of tuberculosis is in the cornea, and especially in the cornea of children, giving rise to the condition already described as phlyctenular or scrofulous keratitis. As the treatment and sociological features of the disease were fully dwelt upon at that place, a repetition is unnecessary. It is only necessary to emphasize that, as with tuberculosis elsewhere in the system, personal hygiene and hygienic surroundings have much to do with the prevention and cure of tuberculosis, and the ophthalmologist who essays to cure local manifestations of tuberculosis must avail himself not only of proper local medicament, but also of all that modern science has taught may be done to combat and control this prevalent infection.

Venereal Diseases.—*Gonorrhœa.*—This disease, affecting the genital apparatus of both male and female, is of particular importance to the eye surgeon in as much as fully 25 per cent. of the blind owe their affliction to it. Affecting at some time or other in their lives from 60 to 80 per cent. of young men and a considerable proportion of women, gonorrhœa is a menace to society which demands the most careful consideration for its control and elimination. How this may be accomplished is still a matter of debate, but undoubtedly one of the most potent agents for its combat is a dissemination among the laity of a knowledge of its prevalence and dangers. No boy or girl should be allowed to approach the age when they may be exposed to its dangers without some knowledge of its existence and should be admonished as to the necessity for purity if for none other than sanitary reasons. As the effects of this disease have been treated so thoroughly elsewhere, it will only be necessary to repeat in this chapter that gonorrhœa is the causal factor in most cases of inflamed eyes of infants at birth (see p. 129). Adults lose their sight by carrying the noxious organisms from the infected genital organ to the eye by the fingers or through the medium of a soiled handkerchief. Less serious ocular complications arise in consequence of a systemic poisoning from gonorrhœa and an implication of the tissues of the eye through the blood.

Of equal importance from a social as well as a medical aspect is the effect of *syphilis* upon the eye. This loathsome disease, affecting probably 10 per cent. of the inhabitants of all the larger cities of the world, is an infectious process, caused by a definite germ and readily transmissible in most of its forms to others. All the tissues of the body may be affected by it, and its course, if treatment be inefficacious, is terminated only with the life of the individual.

Although syphilis is usually acquired in a much less innocent manner than the following, the notes of a case cited in a popular text-book on syphilis is descriptive of one of the modes of contagion:

" A young and upright man kisses a girl at an evening frolic. Shortly after he becomes engaged to marry another girl. A supposed fever sore upon his lips causes him no anxiety until a similar sore appears upon the eyelid of his betrothed and an eruption breaks out upon his own body. Then to the family physician, who finds both syphilitic."

Acquired syphilis begins after a few weeks' incubation with a sore or chancre, as it is called, at the point of inoculation. A few weeks later, the secondary lesions put in an appearance. These take the form of an eruption upon the skin or of acute inflammations of various organs. After these initial manifestations have disappeared, tertiary lesions develop, as a rule in the deeper structures of the body, and while they are often malignant in nature and make great inroads upon the tissues of the body, they are not infectious like the two preceding stages.

In hereditary syphilis, the disease is transmitted by either parent and attacks the progeny with varying degrees of virulence, generally, however, producing characteristic deformities of the teeth, of the skull and the remainder of the skeleton.

As has been learned by a perusal of earlier chapters, all parts of the eye are susceptible to the poison of syphilis and no age is exempt from its ravages. Syphilis frequently attacks the nervous system, and by involving centres in the brain which control visual perceptions and ocular movements, as well as parts of the spinal cord and the nerves supplying the ocular muscles themselves, is indirectly responsible for many complicated and serious affections of the nervous and motor systems of the eyes.

The control of syphilis demands even a more rigorous campaign of education and enforced sanitation than that of gonorrhœa, and the suggestions given to parents and educators in the paragraphs dealing with gonorrhœa are emphasized as being of even greater importance in safeguarding the young against the evils of this widespread disease.

*Diseases of the Sexual Organs.*—In addition to the changes observed in gonorrhœa and syphilis which result usually primarily from diseases of the sexual organs, attention may be called, in the first place, to the ocular diseases which accompany the various forms of imbalance in the vascular and nervous systems which are excited by abnormal menstruation. Latent inflammatory conditions of all kinds are frequently made manifest by the menstrual period, particularly if this be at all deranged or irregular. Styes, conjunctivitis, and keratitis often recur, and even more serious inflammations of the deeper structures of the eye may be brought into activity. At the time of the menopause, hemorrhages into the retina are not uncommon, and an irritability of the nervous system provoked which often manifests itself in a train of asthenopic phenomena. Under such conditions, it is often impossible to prescribe glasses which will enable the eyes to be used with entire comfort. The conjunctiva is also congested and irritable and the eyes water and are sensitive to light. Glaucoma, or hardening of the eyeball, may appear at this time.

In pregnancy, the eyes are not infrequently the seat of pigmentation, and if there be any sublying weakness of the system, such as anæmia or kidney disease, inflammatory conditions within the eye may be awakened which seriously complicate the normal course of labor. On account of the excessive tissue changes which accompany pregnancy, the kidneys, liver and other organs are at times unequal to the task put upon them, and toxæmia or blood-poisoning results. This manifests itself in early pregnancy by pernicious vomiting, later in persistent headache, failing vision, motes, stomach pain, and restlessness. Examination of the urine for albumin being negative, the obstetrician is at times thrown off his guard, and the symptoms are regarded as local and of no particular import, until convulsions occur. It is in cases such as these, that an ophthalmoscopic examination is of particular value, the discovery of retinal hemorrhages and exudates rendering the diagnosis of toxæmia positive, and indicating the necessity for its proper treatment.

It is only recently that obstetricians have appreciated that changes in the retina which have been occasioned by kidney disease and are almost certainly diagnostic of kidney disease, may precede the presence of albumen in the urine, and that the ophthalmoscope may give evidence of disease of organs other than the kidneys, which has been excited by the toxæmia of pregnancy. While the kidney condition which arises in pregnancy is an acute one, in many instances it is engrafted upon a chronic condition, which has existed prior to pregnancy. The ophthalmoscopic examination under these conditions reveals in most instances disease of the retinal vessels and informs the obstetrician of the true condition of affairs. The usual ophthalmoscopic picture of the kidney disease of pregnancy is that of other varieties of Bright's disease, consisting of well marked inflammation of the optic nerves and retina, with extravasations and hemorrhages. This form of retinitis occurs most frequently with the first pregnancy, but may complicate later pregnancies also. The diagnosis of toxæmia once made, the question of saving the life of the mother must now be considered, as ocular symptoms occurring in the course of pregnancy only arise in the event of a profound autointoxication and the alternative of inducing labor artificially must be weighed, the ocular examination being frequently made the crux on which the decision is rendered. It is generally held that in all cases which exhibit ocular symptoms in the first six months of pregnancy, labor should be induced at once, while women in whom the symptoms appear in the last seven weeks should be carefully watched, unless the retinal lesions are very severe. For under these latter conditions the social condition of the parents and the desire of the mother to have a child must be taken into account, especially as the artificial induction of labor under such circumstances does not always improve vision, and as the life tenure of such women, like that of other subjects of Bright's disease, is generally much curtailed. Twenty-five per cent. of such women lose their sight entirely, 29 per cent. make a full recovery, and 47 per cent. but a partial recovery of visual acuity.

In the general blood-poisoning which sometimes follows later, puerperal septicæmia, septic clots may be carried from the womb into the eyes, causing purulent inflammation of all the coats of the eye, with subsequent loss of sight.

Infection following abortion may also result in septic processes in the various coats of the eye.

During convalescence from childbirth, the need of glasses for the correction of even trifling errors of refraction is often manifested. It is well, however, that the mother should refrain from all near use of the eyes until she has thoroughly recovered from the exhaustion and anæmia of labor.

Birth often entails injury to the eyes of the infant. This, as might be expected, is particularly true when instrumental delivery has been necessary. Hemorrhage into the orbit, tears of the lids and even of the cornea, injury to eye muscles, are some of the accidents which are not infrequently observed. When labor is very prolonged, hemorrhage may occur into the retina.

The diseases of the conjunctiva which may originate during the birth of the child are considered elsewhere.

Diseases of the Skin.—On account of the anatomical and embryological relationship which exists between the skin and the mucous membrane of the eye and the superficial layers of the cornea, disorders of the skin frequently involve the eye. This is particularly true of eczema and herpes, and of various growths of a cancerous nature. Of the association of eczema with the eye, consideration has already been given under phlyctenular keratitis. In herpes, blisters may appear upon the cornea and conjunctiva, and occasion painful and persistent ulcers. More or less impairment of vision usually follows. The numerous glands in the lids render these structures peculiarly prone to inflammation, and styes or inflammation of those glands and their surrounding tissues frequently accompany acne in other portions of the face and body. At times true furuncles or boils attack the lids, causing marked tumefaction and redness. Rarely lice (*phthiriasis*) bury themselves in the roots of the lashes and disappear only after they are suffocated by applications of suitable salves.

Dental Affections.—Abscesses in the teeth may by the spread of the inflammation, give rise to orbital abscesses and also to infectious processes within the eyeball. Other dental affections of a less serious nature, in consequence of the association between the nerve supply of the teeth and eyes, occasion various functional ocular disturbances, such as anomalies in the action of the ciliary muscle and reflex disturbances in the visual field, due to vascular changes in the retina and optic nerves.

Diseases of the Respiratory Tract.—The mucous membrane lining the nose is continuous, by way of the lachrymal passages, with the lining of the lids, so that in many inflammatory conditions within the nose, there is more or less irritation of the conjunctiva. Furthermore, the orbital cavities in which the eyes are encased, are surrounded by large air spaces, the so-called " accessory sinuses " of the nose; which communicate with the nose and are lined by a continuation of its mucous membrane.

These sinuses or cavities frequently partake in inflammatory conditions, and by reason of their close anatomical relationship with the eyes and the nerves and muscles of the eyes, occasion various derangements and inflammations of those parts. The most frequent, perhaps, is orbital abscess. In this condition, the tissues of the orbit are inflamed, the eyeball is pushed forward, the lids and conjunctiva swollen and vision may be lost in consequence of involvement of the optic nerve. In other cases, where there is only a stoppage in the avenue of escape of the fluids from the sinus into the nose, the cavity may be slowly distended and the eyeball slowly pushed out of place, in consequence of the encroachment of the walls of the sinus into the orbit. In both of these conditions, unless relieved by operation, not only may vision be lost, but life itself, by an implication of the brain and its membranes.

The ophthalmoscope is frequently of service to the nasal specialist in the recognition of some of the more obscure forms of sinus disease, particularly those situated near the apex of the orbit, and in relationship with the optic nerves. For the ophthalmoscope may reveal a congestion, and a study of the visual field restrictions of various kinds, which are more or less diagnostic of affections of those sinuses. Double vision may result from implication of the ocular muscles, and in rare cases, inflammation of the iris and of other ocular structures may be secondary to sinus disease.

ADENOIDS and tonsillar disease, by depressing the vitality and exciting inflammation in the mucous membrane of the nose and its sinuses, may also be the indirect source of various forms of disease of the conjunctiva and cornea. The author has seen marked protrusion of both eyes caused by an adenoid in the pharynx of a young child, which disappeared after the removal of the growth. In like manner, tonsillar disease may be the means of introducing poisonous material into the system which may act deleteriously upon the tissues of the eye. The most common poison introduced in this way is that of rheumatism, and there seems to be ample evidence that many inflammatory conditions of the iris and of the uveal tract generally are dependent primarily upon disease of the tonsils.

DISEASES OF THE EAR may interfere reflexly with the ocular movements, and excite to and fro movements of the eyes, " nystagmus " so called (see p. 70).

MASTOID ABSCESS has been followed by paralysis of eye muscles and orbital abscesses.

EXOPHTHALMIC GOITRE (Graves' or Basedow's Disease).—This affection, of unknown origin, though probably dependent upon some disturbance of the central nervous system, is characterized in most cases by a group of symptoms which consist of increased frequency of the pulse, enlargement of the thyroid gland, or goitre (Fig. 75), the presence of certain characteristic ocular changes, a fine nervous tremor and nervous irritability.

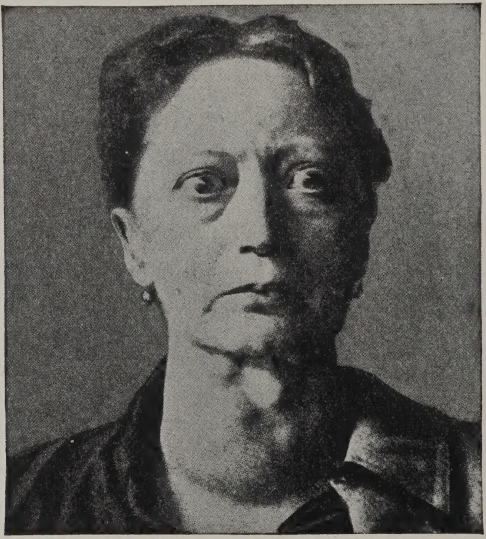

FIG. 75.—A case of exophthalmic goitre. (From Wilbrand and Saenger.)

The most striking ocular symptom is the exophthalmus or prominence of the eyes, which is present in greater or less degree in almost all cases. This protrusion of the eyes may be so great that complete closure of the lids is impossible, and corneal ulceration results from exposure. Usually both eyes are involved; the protrusion may, however, be limited to one. Almost equally constant with the exophthalmus are various anomalies which may be noted in the action of the lids. The most striking of these is the so-called " Graefe lid sign," which consists in an inability of the lids to follow the eyes in all downward movements. This and the "Dalrymple sign," the name given to an abnormal widening of the lid fissure, give to the eyes a peculiar staring expression, and prominence to the sclera or whites of the eyes, and with the exophthalmus serve to attract the attention of even casual observers to the existence of the affection. Other lid symptoms and paralyses of eye muscles may also occur. The slightest evidence of the disease demands instant treatment, as rest and proper medication may often avoid the operative measures which are necessary in advanced cases.

DISEASES OF THE NERVOUS SYSTEM.—As has been stated in a former chapter, the retina is really a peripheral portion of the brain, the optic nerve serving to connect it with the intracranial portion of that important structure. Furthermore, of the 12 nerves emanating from the brain, which control the various organs of the body, six have ocular connections. There is scarcely an affection of the brain or spinal cord, therefore, without ocular manifestations; indeed, often the earliest symptoms appear in the eyes, and the oculist is the first to discover the rudiments of what may become a systemic affection of the greatest magnitude.

On account of the close anatomic relationship between the blood-vessels of the eye and those of the brain, it might be supposed that congestion of the latter would be invariably followed by those of the eye. In consequence of certain local regulating conditions, however, the blood-vessels of the eye frequently escape participation, and it is only when the overfulness of the cerebral blood-vessels has been of long standing that the ophthalmoscope reveals changes in the retinal circulation. When there is an increase in the intracranial pressure, however, positive ophthalmic evidence is the rule. The most common cause of such an increase is the presence of a tumor within the brain, and, in such an event, swelling of the head of the optic nerve is present in about 90 per cent. of the cases, indicating with certainty the presence of such a growth, when all other symptoms, save perhaps that of headache, are absent (see p. 178).

MENINGITIS.—In the event of inflammation of the membranes covering the brain, not only is the optic nerve liable to be involved, but also the nerves supplying the ocular muscles. This happens in consequence of the close anatomical relationship of these structures with the meninges at the base of the brain, and their involvement by the exudate which is the product of inflammation in the membrane. Some degree of optic neuritis is present in some stage in almost all cases of meningitis, and although unfortunately it does not evidence itself early in the disease, it is often of the utmost value in establishing the diagnosis, as the ophthalmologist has this means of differentiating between typhoid fever or pneumonia, on the one hand, and meningitis on the other.

The swelling of the nerve is rarely so great as that occasioned by brain tumor, but the effect upon vision is greater. Those who survive an attack of meningitis are frequently handicapped thereafter by great reduction in vision on account of unpreventable atrophy of the optic nerves. Minute multiple tubercular nodules in the choroid are at times the means of diagnosing acute tubercular meningitis. As they appear, as a rule, only but a short time before death, their discovery is of but little practical importance.

HYSTERIA.—Ocular symptoms frequently accompany this disorder of the central nervous system, and manifest themselves in a variety of ways. The mildest are those already designated as asthenopia, or fatigue of the ocular apparatus after the slightest near use. In severe cases, partial or even total blindness may supervene, the loss in vision being purely psychic and not dependent upon any demonstrable structural change. Such manifestations not rarely follow accidents of various kinds, and are often difficult to differentiate from the visual losses assumed by malingerers for the purpose of recovering damage awards after accidents. Usually, however, a careful study of the fields of vision and an application of the tests known to ophthalmologists for the detection of fraudulent symptoms of blindness enable the diagnosis to be made. Drooping and spasm of the lids are occasionally observed in hysteria and at times the extra-ocular muscles show contractions.

INSANITY.—The ordinary forms of gross mental aberration are unattended with constant or dependent ocular signs or lesions, and as in many such states there is no evidence of anatomical change within the brain, the eyes also show no deviations from the normal. Conversely, loss of sight does not, as a rule, entail mental derangements. In individuals, however, who are intellectually weak, it can be readily understood how the loss of so important a sense as sight might be of serious moment and even sufficient to break the fragile chain of cerebration and cause insanity.

The author has elsewhere recorded two such cases, in which increasing blindness from the development of cataracts caused violent mental aberration. Operation upon the cataracts and the restoration of vision was followed almost immediately by a full and permanent return of the mental processes. Similar cases have been reported by other operators.

The delirium which manifests itself in about 10 per cent. of all cases operated upon for cataract, some days after the operation, is attributable to the constraint necessary for a time after the operation, to certain nutritional disturbances of the brain attending the enforced restrictions in diet, and to the intense preoccupation which seizes some individuals prior to and after the operation. The delirium is usually transient, and yields readily to proper management.

*General Paralysis of the Insane.*—Some of the earliest symptoms of this common form of insanity are ocular and the clinician is often enabled by the pupillary changes present to differentiate this serious condition from some transient mental aberration. It would be unwise, however, to place too much dependence upon such pupillary changes alone, and it is only in conjunction with other indications that the clinician will attempt to interpret and draw his inferences from them. Hallucinations (of sight, at times, limited to one side of the field of vision) are common, and may appear early in the disease. Paralysis of the various eye muscles may also occur, and at times the optic nerves show evidences of degeneration.

Deformities of the Skull.—The various forms of cranial malformation, be they microcephalia, a too small skull, or megalocephalia, a too large skull, are apt to be accompanied by some serious disturbance of the optic nerves, either in consequence of pressure exerted upon the nerves as they pass through the optic canals narrowed by the defective development of the bones of the skull, or from some involvement of the tissues of the nerve by the inflammatory condition primarily concerned in preventing the cranial growth. Hydrocephalus is frequently attended with varying degrees of visual disturbance dependent upon the amount of pressure exerted upon the optic nerves.

ACROMEGALY.—This disease, which is characterized by an overgrowth of the hands and feet, and striking change in the facial expression, due to the overdevelopment of the structures composing the features, possesses almost characteristic visual symptoms. There are often marked prominence of the eyeballs, occasional palsy of eye muscles and frequent changes in the extent of the visual fields, the most common of these being areas of dimness in the centre of vision and loss in the outer halves of the visual fields.

DISEASES OF THE SPINAL CORD.—Pupillary, muscular, and optic nerve changes are more or less common in many forms of disease of the spinal cord, but in locomotor ataxia, or tabes, the most common form of spinal disease, they constitute a constant and most important part of the symptom complex. The most significant of these are the pupillary symptoms, as they appear early and often supply the first positive indication of the nature of this serious disease. In addition to irregularities in their size, the pupils, when exposed to the light, do not contract as is normally the case, but remain unchanged, narrowing, however, as the gaze is directed to some near object. Although present in other morbid states of the nervous system, this pupillary phenomena is an almost constant factor in locomotor ataxia and enables the oculist, who is not infrequently the first to detect it, in the routine examination of the eyes for glasses, to direct the attention of the patient to the necessity of a more extended examination of his nervous system.

Paralysis of one or more of the ocular muscles is also common and a sudden attack of double vision may be the means of directing medical attention to the existence of tabes. Such double vision is frequently transitory, and, disappearing in a few days, deceives the patient as to its significance and gravity. In the latter stages, such palsies are more apt to remain constant, and are frequently distressing and annoying to the individual. It is at this time that visual disturbances from optic nerve disease appear, and in a certain number of cases almost complete blindness supervenes.

As locomotor ataxia in the vast majority of cases is of syphilitic origin, it is at times amenable to antisyphilitic treatment. The importance of the early recognition of the disease is apparent, therefore, and additional demonstration is given of the value of a careful systemic examination of all the parts of the eye in all refraction work, and offers an additional argument why such tests should not be relinquished to opticians and optometrists, who are unlearned in medical science, and unable to detect or appreciate functional deviations which may often be significant of serious disease of the general system (Plate II, *E*).

Infantile Paralysis; Anterior Poliomyelitis.—This disease of the spinal cord may also affect the brain and sublying nervous structures and involve the eye muscles. The author has reported several cases of this nature, in which a permanent condition of strabismus, or cross-eye, followed. He has also recently examined a child who suffered total blindness from disease of the optic nerves, consequent upon this mysterious scourge of childhood.

# CHAPTER XVI

## WOUNDS AND INJURIES

NOTWITHSTANDING the protection afforded the eye by the orbit and the lids, its exposed position makes it peculiarly liable to accident, while the delicacy of its structure converts an injury which would be of trifling significance elsewhere into a matter of extreme seriousness to the happiness and earning power of the individual. The character and nature of eye wounds and injuries are manifold, ranging from the lodgement of a minute foreign body under the lid to the complete disintegration of the globe by a powder or dynamite explosion.

Many ocular injuries befall children and the eye surgeon is frequently called upon to do his utmost to save eyes that have been injured by perforation by forks and knives and scissors, by hat pins, by pens and pencils, and all manner of household articles. The multiplicity of objects which can destroy sight by careless handling or improper use is appalling, and no more valuable or humane message can be given the layman than the plea for rigid and unceasing care upon the part of parents, nurses and all those having the care of children, that all pointed articles be removed from the reach of these little ones.

*When a foreign body lodges in the eye,* such as a cinder or dust granule, the natural tendency for the patient is to rub the eye, not only on account of the fancied relief afforded by the friction, but also in the hope of dislodging the offending body. This action, however, is only deleterious, serving to irritate the eye and imbed the foreign substance more deeply. The proper procedure to follow in cases of this kind is to grasp the margin of the upper lid with the thumb and finger of the hand and to draw it outward and downward. By this simple maneuver the foreign body will frequently become engaged in the lashes of the lower lid and the eye freed of its irritant. If this device fail, the aid of another person must be evoked. This person should station the patient in front of a window, and carefully inspect the visible portions of the eye and conjunctiva. Should the foreign body be seen, unless it is imbedded in the cornea it may easily be removed by the dampened point of a handkerchief. Should it still remain hidden, the helper should request the patient to look downwards, then, grasping the margin of the upper lid with the thumb and forefinger of the right hand, the lid should be pulled downwards, while, with the left hand, the upper margin of the cartilage of the lid, *i.e.,* a point about one-half inch above the eye-lashes, should be gently depressed with the blunt end of a pencil, while the margin of the lid is gently rolled back with the thumb and finger already engaging it. By forcing the patient to continue looking fixedly downward, a full view is had of the conjunctiva lining the upper lid and covering the globe, and a foreign substance may readily be removed in the manner just described. The eye may then be bathed in cold water containing boracic acid, if this powder be at hand, and in a few minutes the eye will recover its normal sensibility.

*If the foreign body is situated on the cornea* and cannot be dislodged by gentle contact with the handkerchief, medical aid should be sought. The damage inflicted by well-intentioned but unskilled attempts at removal from the cornea of foreign bodies which have become firmly imbedded in the tough substance of that membrane is extremely grave and every eye surgeon of experience has been compelled to remove eyes which have been lost by infection consequent upon the removal of such bodies by dirty toothpicks, blades of knives, etc. Stringent measures should be adopted in all industrial establishments forbidding, in earnest terms, the attempts of fellow workmen and other so-called " handy men " to remove such bodies from the eye. Competent medical aid is alone capable of dealing with such cases.

Nasal catarrh, in consequence of exposure to draughts and the inhalation of dust and other irritating substances, is common among workmen, and not infrequently disease of the lachrymal passages takes part in this inflammation of the mucous membrane of the nose. Once the protecting covering of epithelial cells of the cornea is broken, microorganisms present in the diseased lachrymal sac gain entrance into the tissues of the cornea, and, in a few hours, a purulent inflammation arises which usually leads to the total loss of the eye. The careful surgeon will discover the existence of such a complication and will take means to combat it, before pronouncing even a simple wound of the cornea to be free from danger.

After the removal of foreign bodies, the eye should be carefully bandaged, to exclude irritants and to hasten the reformation of the epithelial covering. If inspection shows that the corneal tissue has been much damaged by the injury, ice compresses and the instillation of atropine are demanded.

A painful and often troublesome injury results from *a scratch of the cornea by a finger-nail* (Fig. 76), this accident happening not infrequently to mothers by an unexpected blow from a child's hand. Prolonged bandaging and the best of medical care is usually necessary before the healing of the torn cornea is attained. Women also suffer injury to the conjunctiva and cornea from burns by curling irons. If at hand, a small quantity of white vaseline should be placed inside the lower lid, the eye bandaged, and medical assistance immediately obtained.

The cornea is also frequently injured by *scratches by twigs* and branches of trees, and the author has seen several cases where severe injury was inflicted by the sharp points of *a chestnut burr.*

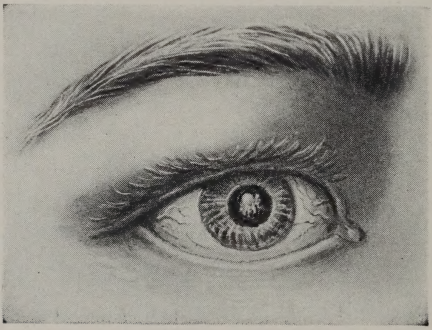

Fig. 76.—Erosion of cornea from finger-nail injury.

The lodgement of *caterpillar hairs* within the eyelids may give rise to a very severe inflammation of conjunctiva and cornea, and may threaten the integrity of the globe.

Injuries are sometimes confined to *the lids.* The author has, upon several occasions, seen the upper eyelid almost torn away by hooks of various kinds. The skin of the lids is frequently the seat of burns, and in the event of an explosion, if the spontaneous closure of the lids has not been quite quick enough to prevent, burning substances may gain access to the conjunctival sac and may injure the eye itself.

Perhaps the most common type of *chemical burns* is that due to unslaked lime, the lime being splashed into the face of mortar-mixers and plasterers. When this occurs, the eye should be immediately flushed with an excess of water and the patient hastened to an eye surgeon. At times, burns are occasioned by acids, when a similar course of treatment should be instituted. Ordinarily advice is given to counteract burns from alkalies, such as lye, ammonia, and lime, with weak acids like vinegar, and those from acids with weak alkalies like dilute soapsuds. These agents are not, however, always at hand, and water must be relied upon to rid the eye of the offending substance.

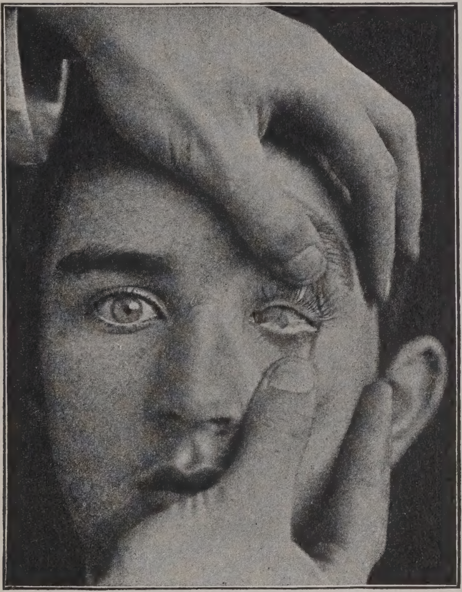

Fig. 77.—Adhesion of the lid to the globe after lime burn.

Burns are always of serious moment, often destroying the eye, although the immediate consequence of the accident seems trivial. Adhesions of the lid with the globe (Fig. 77), corneal opacification and ulceration, and actual shrinking of the globe itself are some of the sequelæ which are observed after this class of injury.

While surface wounds are often serious, *injuries which cause a perforation of the globe* (Fig. 78) are invariably so, not only on account of the damage done to structures vitally concerned with the integrity of the eye as a visual organ, but also on account of the additional danger which they occasion of the eye being lost from sepsis, in consequence of the introduction of infective material.

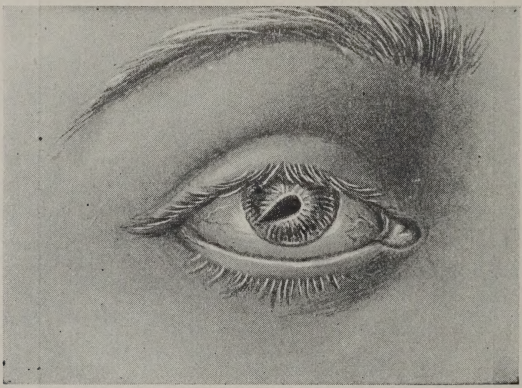

Fig. 78.—Perforating wound of the cornea with prolapse of the iris.

The simplest form of perforating injury is one which penetrates the cornea, but does not involve other ocular structures. The prognosis for sight and uncomplicated healing depends naturally upon the character and extent of the injury. A clear-cut wound, inflicted, for example, by a keen blade of a small knife, may heal rapidly, and interfere but slightly with vision, though the usually attendant adhesion of the iris to the cornea, which occurs when the iris is permitted to come into contact with that membrane, in consequence of the escape of the aqueous humor, may necessitate operative measures later. Jagged tears of the cornea may, on the other hand, despite the healing process which is often accomplished by the surgical covering of the wound by transplanted flaps of conjunctival tissue, leave the eye totally blind, though the sublying structures may have escaped injury.

Fig. 79.—The deadly scissors and the innocent victim.

When an eye is injured by *hat pins, pen-knives, blades of scissors* (Fig. 79), and the dozen or more articles and implements in common use, not only is the cornea perforated, but the lens and iris usually suffer as well. Even without treatment, providing the object inflicting the injury has been clean, in rare cases, the wound of entrance may close after a time, and the eye recover with more or less impaired vision. Usually, however, unless prompt treatment is instituted, the eye is lost from infection or subsequent shrinking.

At times the iris escapes in perforating injuries, and the lens alone is involved. The capsule of the lens being broken, the aqueous humor enters the lens substance and causes a general opacification of that structure, preventing the entrance of rays of light into the eye. After a time, however, a diminution in the volume of the lens will be noted, and a gradual disappearance of the opaque lens matter takes place by absorption. Necessarily, good vision can then only be obtained by the superposition of a strong convex spherical lens before the eye, to replace the crystalline lens which has been lost, a correction which is rarely tolerated in comfortable binocular vision.

Wounds which penetrate into the vitreous and are of large extent are usually attended with more or less loss of that structure and collapse of the globe. Injuries which involve the ciliary body are always regarded with grave concern by the surgeon, as experience has shown that this class of injuries is particularly liable to be followed by sympathetic involvement of the fellow eye.

A person may suffer injury to an arm or leg and no inflammation be excited in the fellow member, no matter how severe the wound in the injured part, but if an eye is injured or inflamed, especially if, as has just been cited, the ciliary body is involved, there is always the possibility of *a sympathetic inflammation* occurring in the fellow eye. This peculiar characteristic has long been recognized, and it is for this reason that surgeons urge early removal of eyes which are at all likely to give rise to this trouble; for once the inflammation has been transferred, though but in the slightest degree, no treatment or operation can stay its progress, and the sympathizing as well as the injured eye is usually lost. One of the saddest experiences of the eye surgeon is an unsuccessful pleading with an ignorant or stubborn patient to permit the removal of a worthless and dangerous eye, a procedure which would remove all menace from its fellow, and to hear the demand for help which comes later, after the good eye has become involved and no surgical intervention or treatment is of avail.

It would seem almost at times that the decision of whether an operation shall or shall not be performed should not be left with the patients and their friends, who are, as a rule, in no position to arrive at a sane judgment in the matter, but should be referred to some kind of a medical court. Apart from the needless suffering entailed by this self-inflicted blindness, the subject is of importance from an economic standpoint, as most of these individuals are incapable of supporting themselves and become cares upon the State.

Gun-shot Wounds of the Eye.—In the autumn, during the open season for shooting game, gun-shot wounds of the eye are not infrequent. These are usually occasioned by small shot, and the wounds inflicted vary in proportion to the number of shot entering the eye and the parts affected. As a rule, wounds of this character are extremely serious, and often cause the loss of the eye. Shot lodged within the eyeball are readily located by the X-ray, but being non-magnetizable, their removal is attended with great difficulty and often leads to the loss of the eye. If the globe has been perforated and the shot lodge without the eye, useful vision may be saved provided no part of the eye vital to sight has been injured. Wounds with balls of large calibre are usually fatal to sight and generally demand the immediate removal of the eye. A not infrequent loss of sight from pistol wounds are those self-inflicted by would-be suicides, who, holding the barrel of the pistol to the temple in the expectation of blowing out their brains, advance the weapon too far forwards, and injure instead one or both optic nerves just before they enter the eyes.

Another not uncommon source of injury is from a bullet or stone hurled against the eye from a *sling-shot.* In cases such as these the globe is frequently not perforated, the injury resulting from the blunt force with which the missile strikes the eye. Rents in the iris and choroid, dislocation of the lens, and detachment of the retina are the usual sequelæ.

It is beyond the scope of this work to describe the frequent and extensive injuries inflicted upon the eyes in war. They vary from the complete blowing out of the eyes to every conceivable form of eye injury, the amount of damage done depending upon the nature and form of the projectile and the part of the eye injured.

Injuries from Balls.—These may be inflicted by balls of all kinds, *i.e.,* cricket, base-ball, golf, tennis, racquet balls, etc., and, generally speaking, the smaller the ball the greater the danger to the eye. When a cricket or base-ball strikes the eye, it often happens that the rim of the orbit, the bony receptacle in which the eyeball lodges, receives the force of the blow and the eyeball itself escapes. Unfortunately, however, the consequences to vision may be very serious, for it not infrequently happens that the force of the blow is great enough to produce a fracture in one of the walls of the orbit and the extension of the fracture to the apex of the orbit causes a severance of the fibres of the optic nerve, as that structure passes through the optic foramen, as it emerges from the cranial cavity into the orbit. The prognosis, therefore, in cases of sudden blindness following such injuries, is hopeless. When, however, an interval of time elapses before the loss in vision becomes manifest, there is some chance that sight may be regained, as in the latter case the blindness may have been caused by a hemorrhage into the sheath of the nerve, which is capable of subsequent absorption. The author remembers a case of a young father who, while romping with his little son, received a violent blow over the eye from his child's head. There was no loss of vision until some hours later and fully a day elapsed before the eye on the injured side became totally blind. After several days of blindness, full visual acuity was gradually regained.

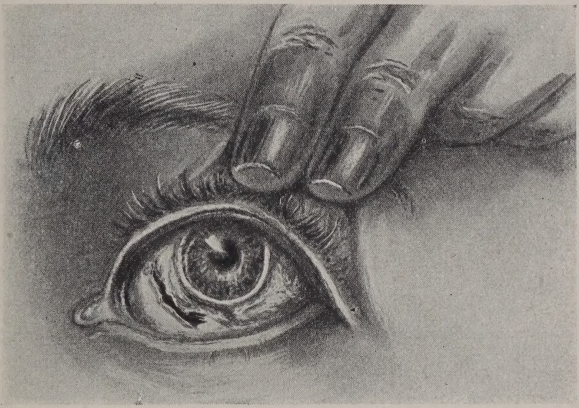

Fig. 80.—Rupture of the eyeball.

The circumference of the orbital aperture is too great, however, to protect the eye from injury by small balls, and most eyes struck squarely by racquet and golf balls are hopelessly lost, the envelope of the eye being split (Fig. 80) and the contents of the eye extruded as a result of the accident. If the blow has been a glancing one, the injury may not be so serious, and the globe, partially flattened for the moment by the blow, may escape without injury to the cornea and sclera. Ordinarily, however, in such cases, the iris or choroid is torn, the lens dislocated, and, what is usually of more serious moment, the retina detached (Fig. 81).

In addition to participating in the class of injuries just mentioned, *golf balls* may menace the integrity of the eye in quite another manner. During the past few years a number of cases have been reported where severe burns of the eye have been occasioned by boys and others, mostly caddies and professional golfers, cutting into the balls to ascertain their contents (Fig. 82). Consequent thereto an explosion of extreme violence occurs, the semifluid mass contained in the core of the ball being expelled in all directions. Several eyes have been totally lost in this way and others severely injured. Fortunately, this unhappy experience does not follow the incision of all golf balls, but appears to be limited to two kinds of balls, which were in common use for a time on account of their lightness. It would appear from an analysis which was made of the contents of several of the balls after the explosions had occurred, that the core consisted of a mixture of barium sulphate and a free alkali. In balls of another make, the core

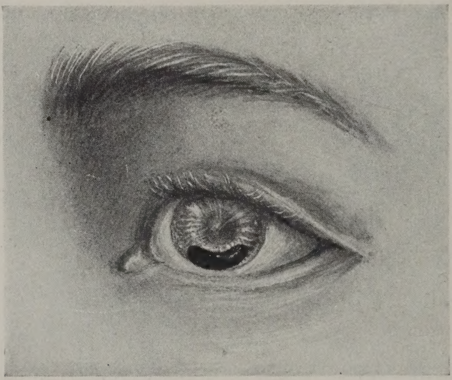

FIG. 81.—Blood in anterior chamber following blow upon the eye.

seemed to be made up of zinc chloride. Owing to the initiative of the Pennsylvania Commission for the Conservation of Vision, the United States Golf Association caused placards to be displayed in all the club houses of the association, warning of the danger of cutting into golf balls. The Massachusetts Legislature also passed a bill prohibiting the sale of balls which contained any caustic fluid.

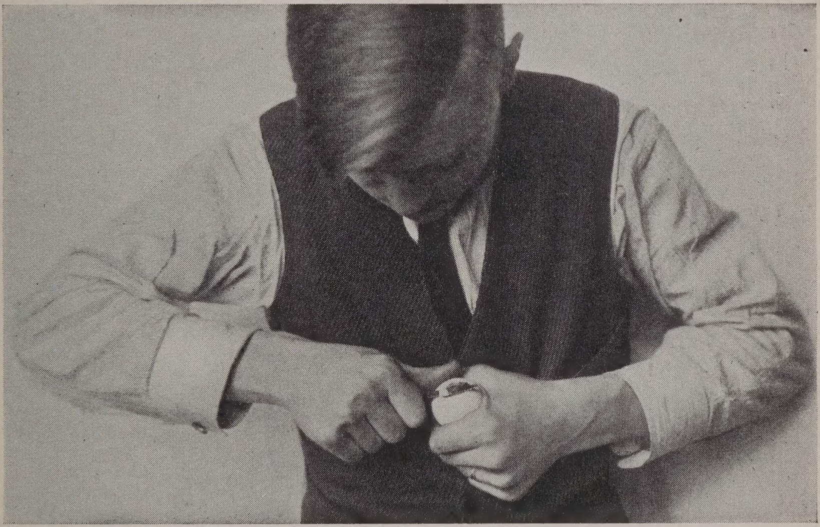

FIG. 82.—Cutting into a golf ball. The ball, at the centre, contains an acid which explodes when exposed to the air. A great many cases of loss of sight have been reported as a result of curiosity of the contents of golf balls.

While the two makes of dangerous balls have been largely withdrawn from the market, it is not unlikely that some of the balls may still be in circulation, so that the caution recommended by the golf association should still be given publicity, and caddies and others warned under no circumstances to investigate the contents of golf balls of any description.

SNOW BLINDNESS.—The dazzling reflection of the sun's rays from snow and ice fields is often a source of great annoyance and danger to mountaineers and arctic explorers. Unless properly protected by some form of colored or smoked glass, the excessive amount of ultra-violet rays burns the conjunctiva or even the cornea, and may cause serious inflammation. For protection against snow blindness in arctic, antarctic, and mountaineering expeditions, the best frame is the common open spectacle frame, fitted with large mussel-shaped smoked or tinted glasses. Glasses tinted yellow-green entirely absorb the ultra-violet rays and the colors of the landscape, seen through them, are not much modified. All more or less hermetical arrangements of goggles for the exclusion of side lights have been found by travellers to be superfluous and serve only to moisten the glasses.

LIGHTNING STROKE has been followed by cataract and various other changes in the interior of the eye. The author observed a case of diffuse œdema of the retina with total loss of sight follow this accident. Full vision was ultimately obtained in each eye.

## INDUSTRIAL INJURIES TO THE EYES[1]

Statistics show that in the United States 75,000 persons are killed annually through accidents. Of this number, 35,000 die from industrial injuries. Of 2,000,000 annual non-fatal accidents, probably 160,000 are accidents to the eyes.

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[1] Contents of this section based on a paper by the author before the Department of Industrial Welfare and Efficiency, Bureau of Commerce and Labor of the State of Pennsylvania, at annual meeting, November 23, 1916, from material furnished by the National Committee for the Prevention of Blindness.

Although the last census records the number as smaller, there is strong evidence to place the number of blind in our country at about 100,000, of whom approximately 10,000 lost their sight as the result of accidental injury in industrial occupations. Quite apart from the suffering and unhappiness entailed by these accidents, which cannot be appraised in dollars and cents, it has been estimated that it will cost the nation nearly ten million dollars to care for these blinded workmen during the remainder of their lives.

According to a statement recently issued by the National Association for the Prevention of Blindness, the industries providing the greatest number of industrial accidents to eyes are foundries, galvanizing plants, machine factories, metal and wood working plants, lead and color factories, chemical works, and the dusty and poisonous trades. The classes of workmen showing the largest percentage of eye accidents are smelters and furnacemen, welders, grinders, and machinists, furnace helpers, and railroad workers. It may appear rather strange that this last class, railroad men, are so subject to eye accidents in their work, yet the records of the great railway systems which operate one-half of the total mileage in the United States, admit for the period 1908–1910 seven cases of total disability, *i.e.,* loss of both eyes, while three hundred and ninety suffered the loss of one eye. Railroad employees exposed to eye injuries preventable by goggles are chippers, riveters, boilermakers and grinders.

One of the greatest menaces to the eye is burns from *molten metal.* This may occur in filling the ladle with the metal while it is still in a liquid state, or when the latter is being poured into the mould, the sparks flying in all directions, frequently burning the face and eyes of the workmen. Most serious are the explosions which follow when molten slag or lead are permitted to come in contact with vessels or implements containing moisture, the superheated steam thus generated blowing the hot metal with great force for considerable distances (Figs. 83, 84, and 85). At times considerable masses of molten metal may force their way between the lids and the globe, and, owing to the physical phenomena of calefection, whereby the tissues are separated from the metal by the sudden evaporation of the fluid on the surface of the eye, a perfect mould of the conjunctival cul-de-sac is formed, comparatively but little damage being done to the contiguous structures. At other times, however, the injurious effects of such explosions is very great, and the author remembers to have seen a case in the practice of a colleague where a large fragment from

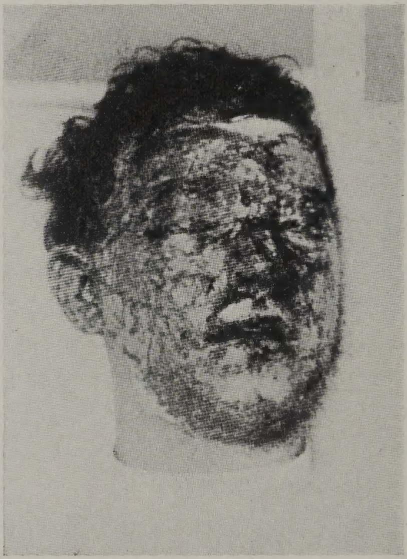


FIG. 83.—Man with eyesight destroyed and face badly disfigured by burns from molten metal.

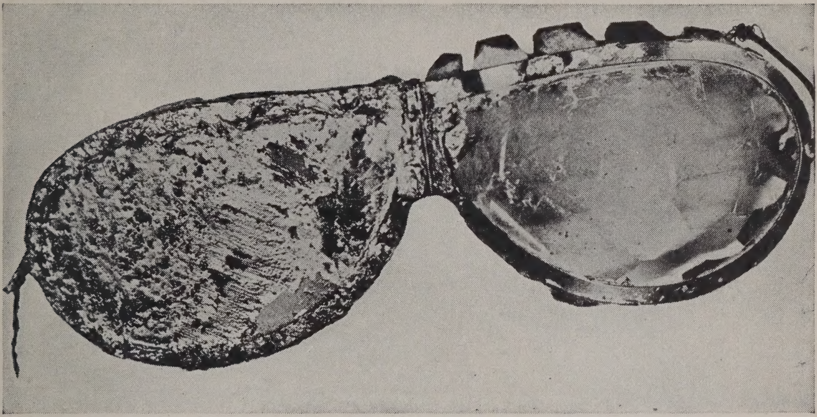


Fig. 84.—In this case the babbitt metal completely covered one eye and if employee had not been protected by this safety precaution, he would undoubtedly have lost both eyes, instead of receiving but a slight burn about the face.

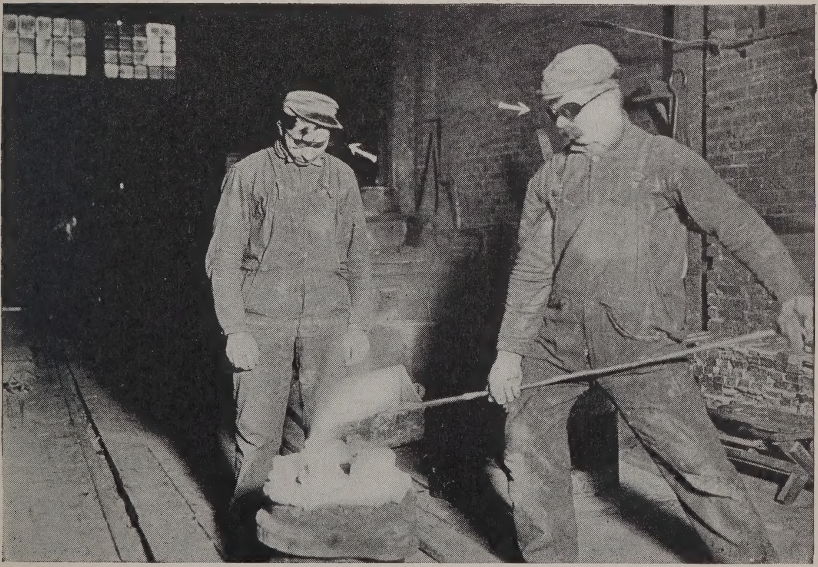


Fig. 85.—Glasses used by workmen pouring babbitt.

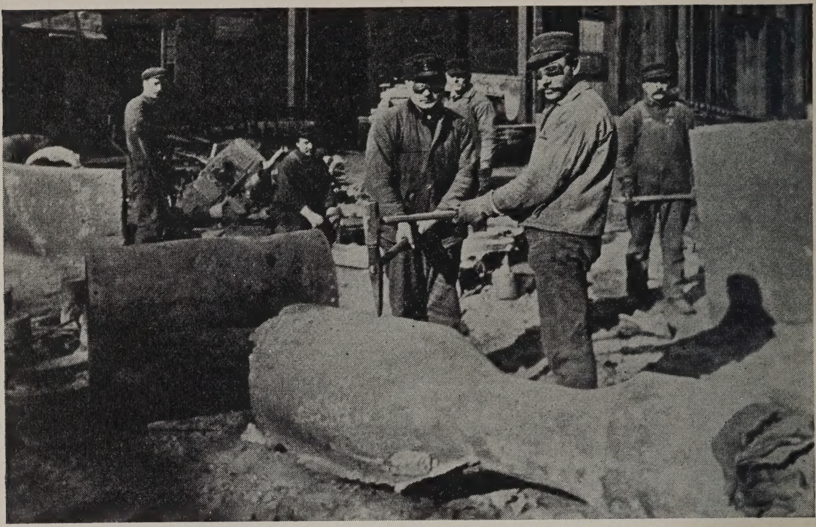


Fig. 86.—A foundry chipping yard, eyes of workmen properly protected by goggles.

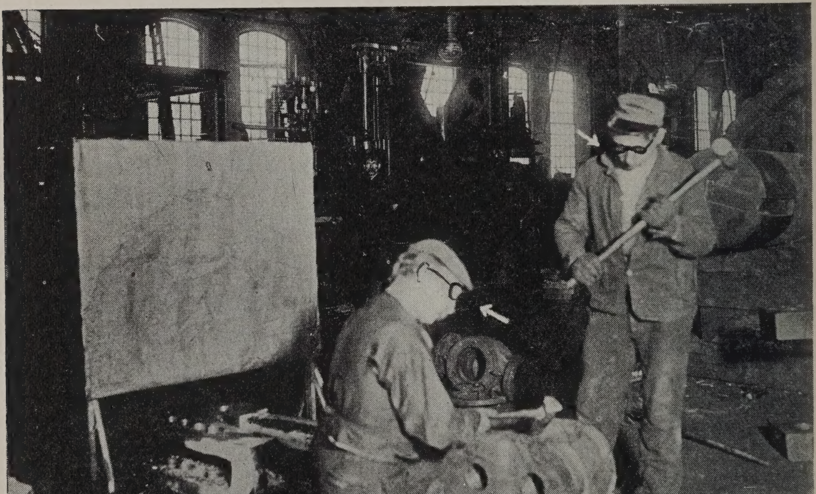


Fig. 87.—Glasses used by workmen chipping wheels; also burlap guard to catch flying chips of steel.

a red-hot chisel forging completely destroyed the eye of a bystander.

Of all the various workmen engaged in the industries, the most liable to ocular injury are *chippers* (Figs. 86 and and 87). Chippers are men who remove the rough surface from steel castings which frequently remain after the molten metal has hardened, this being accomplished either by a hand chipper or by means of the more modern pneumatic implement. The fragments dislodged fly from the casting with great velocity and force, and frequently injure not only the eyes of the chippers themselves, but those of their fellow-workmen or the passerby. Goggles are imperative for all those engaged in chipping or in the vicinity, and screens composed of wire or burlap should be so placed that they act as buffers to the flying particles. Flying scale is frequently thrown off from the rolls of a blooming mill and

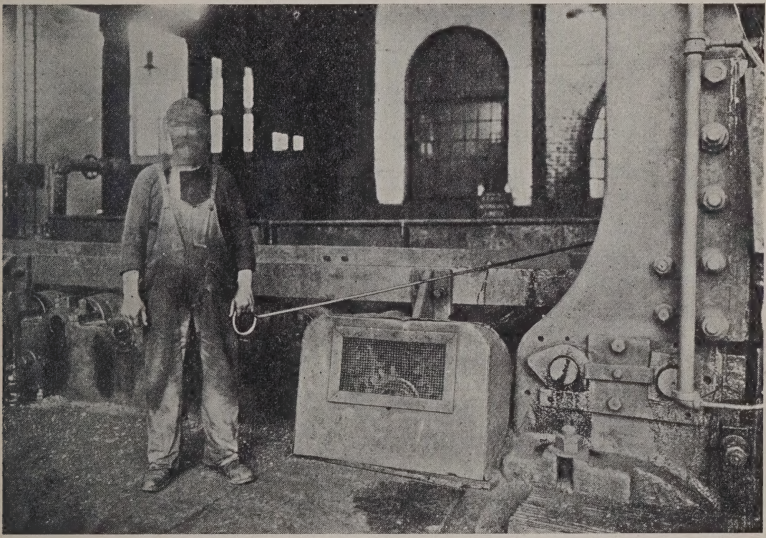


Fig. 88.—Man with hood of brass wire, standing before furnace.

employees engaged in this work should wear protecting masks of fine brass netting (Fig. 88).

When water and steam is turned into *a water-gauge,* with which all boilers are provided, the pressure at times is great enough to burst the glass and to blow the fragments into the face of the engineer observing the gauge. In a recent year in Massachusetts seven men lost the sight of both eyes and one workman that of one eye from the bursting of such gauges (Fig. 89). This has been obviated by providing the glass column with a protecting shield of brass which covers the glass when turning steam and water

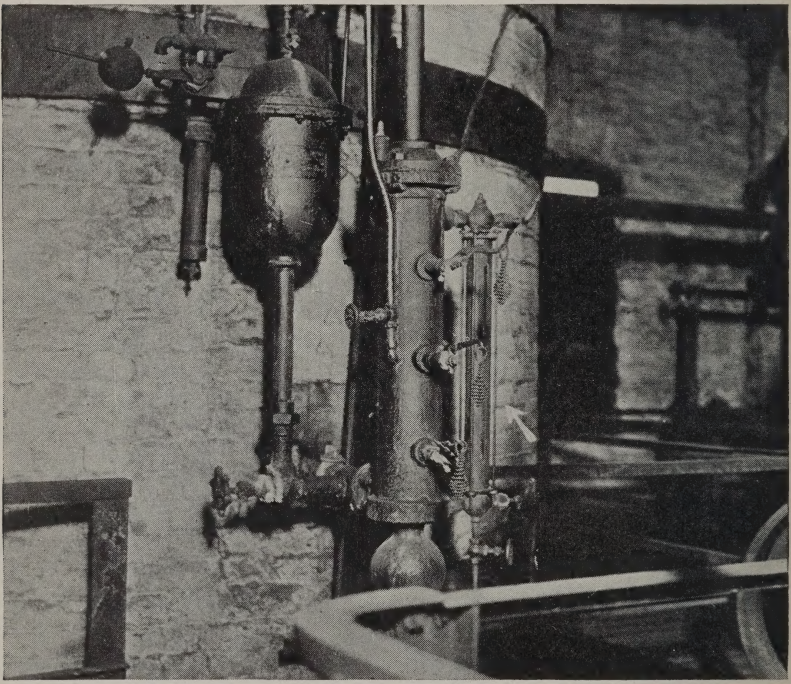


Fig. 89.—Water gauge glass on boilers, protected with brass casting, having a small slit in the front and back. The gauge of water can be viewed from the ground. There is an incandescent light placed at back of glass to reflect the stage of water.

into the gauge and is capable of being rotated to the side when the danger of this act is over and it is necessary to ascertain the registration of the water in the boiler. The New York Central roads have installed an admirable model of this device in their works, and no accidents to the eyes have occurred from bursting gauges among their many employees since it has been in use.

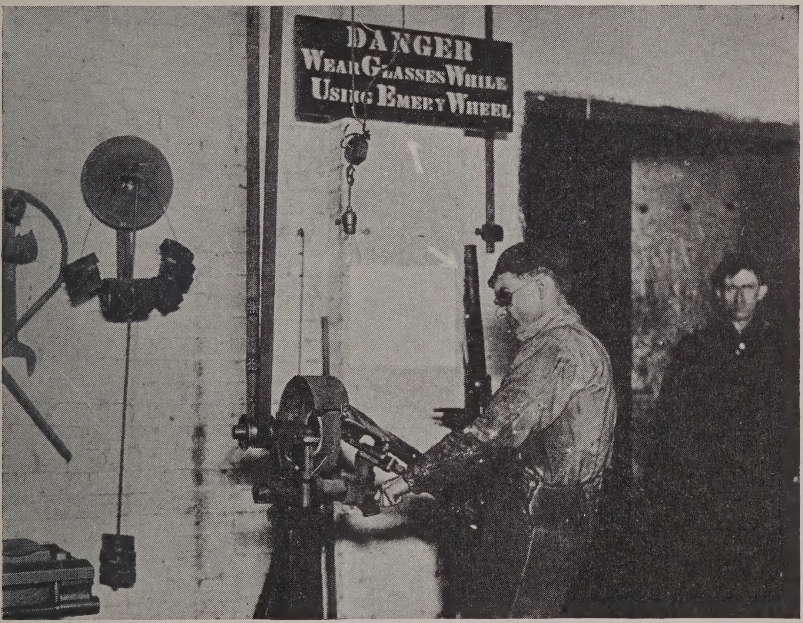


Fig. 90.—Glasses used by operator at emery wheel; also notice warning for men to wear glasses.

The *emery wheel* is a constant source of danger. When operated at high speed, it may burst and its fragments kill or injure workmen close at hand. Most serious are the burns and scars inflicted upon the cornea of those who work with unprotected eyes, by the dust given off from the wheel while tools and instruments are being ground upon it. The breaking off of fragments from the tools in the process of grinding provides, however, a still greater source of danger to the eyes, and many an eye has been blinded by these flying particles of steel (Fig. 90). Many manufacturing establishments now protect their workmen from injury from bursting wheels by encasing them in hoods of steel, and the eyes of the men from broken particles of wheel and from flying chips by shields made of heavy plate glass, the transparency of the glass permitting the workman to observe the tool he is grinding. Most wheels are also provided with exhaust connections from the rear of each hood to a forced draft pipe, which carries away much of the dust by a vacuum system.

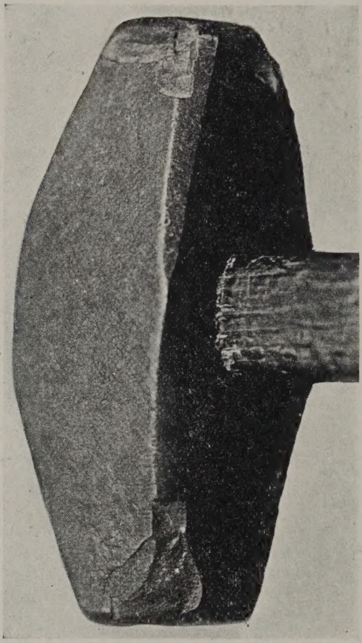
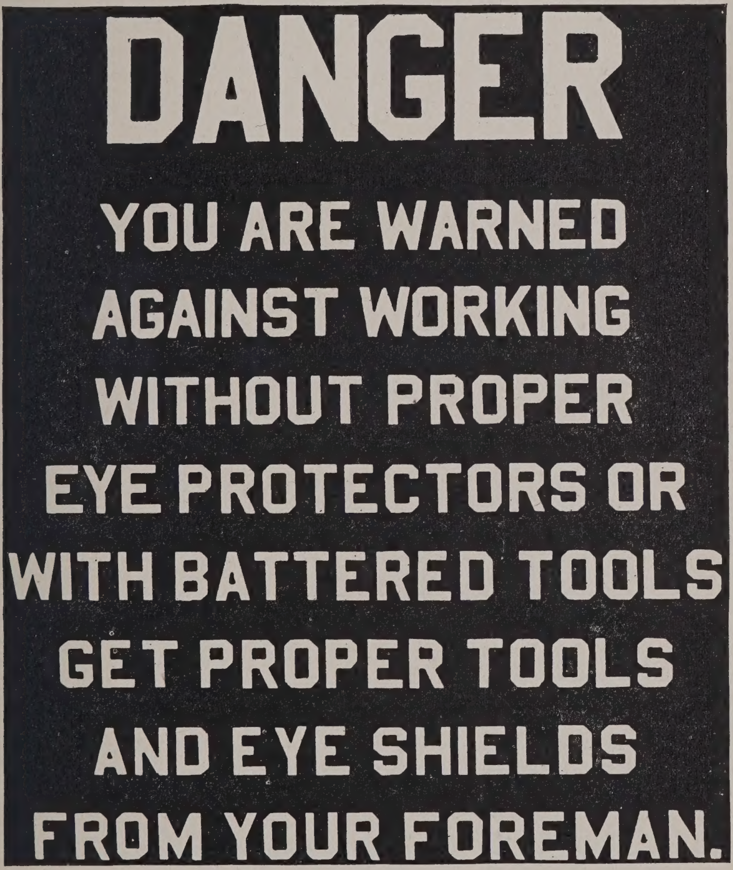


FIG. 91.—Hammer—showing chip.

Another frequent source of danger to the eyes, not only in the industries but also in domestic life, is the breaking of steel particles from the head of *tools which have become flattened over or " mushroomed "* from long use (Fig. 91).



DANGER

YOU ARE WARNED
AGAINST WORKING
WITHOUT PROPER
EYE PROTECTORS OR
WITH BATTERED TOOLS
GET PROPER TOOLS
AND EYE SHIELDS
FROM YOUR FOREMAN.

Fig. 92.—Warning placard posted in the workyards of the Tennessee Coal, Iron and Railroad Company.

While mushrooming is especially liable to happen to cheap tools, it may occur also in the best hand-wrought implements, for a hammering tool must be fairly soft to prevent its becoming brittle, and if used too long it will naturally flatten out. The prevention of accidents from this source consists in sending the tools to the blacksmith just as soon as they begin to show signs of wear. The Tennessee Coal, Iron, and Railroad Company has considered this danger of sufficient importance to cause a warning placard to be posted in their workyards (Fig. 92).

Some of the most serious and ofttimes hopeless cases the ophthalmologist is called upon to treat occur from *blasting operations,* either in mining or in excavating for foundations, etc. Such accidents result either from the premature explosion of cartridges with too short fuses, or by delayed explosions, the injuries occurring when the workmen, after what they suppose sufficient time has elapsed after the charge has been fired, seek to investigate the failure of the explosion. At other times, when a number of cartridges have been fired by an electric current, the workmen clearing away the débris caused by the explosion are seriously injured by the delayed explosions of several of the cartridges which had failed to go off at the initial charge. The injuries to the eyes in such cases are frequently caused by little bits of copper from the exploded caps of dynamite or from fragments of rock, substances incapable of magnetic attraction, and on that account extremely difficult and often impossible to remove from the eyes.

Another source of injury to the eyes is from *exposure to an excessive amount of heat and light rays,* emanating from furnaces in which glass and metal are being subjected to a temperature of great magnitude. In welding of metals by the electric arc, the oxygen-hydrogen flames or some similar high temperature medium, a temperature of from 4000° up to as high as 7500° F. is frequently attained

(Fig. 93). The ultra-violet rays generated by this process are extremely harmful to the eyes, inducing changes which may lead to blindness. In some of the processes it is necessary for the workmen in charge to gaze intently into the furnace and watch for the change in color of the molten mass which indicates that the desired transformation in its composition has been attained. Workmen subjected to such intensity of light and heat radiations must wear proper protecting devices, and welders are usually equipped with a complete metal helmet, which is absolutely light-proof, except for the ocular apertures, which are covered with certain forms of colored glasses. Mention will be made later of the best kind of glass for this purpose (Fig. 94).

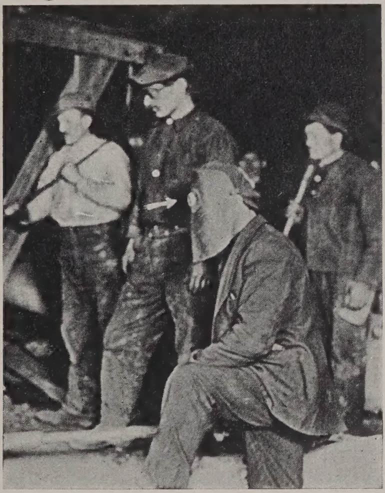


FIG. 93.—Mask used by operator to protect eyes and face while using electric welding machine, the rays from which are very destructive.

Faultily constructed *electrical appliances* may be a source of eye injury, blindness from cataractous formations in the lens sometimes occurring in eyes subjected to the blaze of light from a short circuit. The author had under his care a few years ago a workman in one of the large coal companies of the State who had lost his sight in this way, but who fortunately regained it after a successful cataract operation (Fig. 95). Venturesome electricians occasionally essay to light a cigarette from an electric arc, ofttimes with disastrous consequences. To avoid accidents from electric flash, all switches, fuse-boxes, etc., should be enclosed.

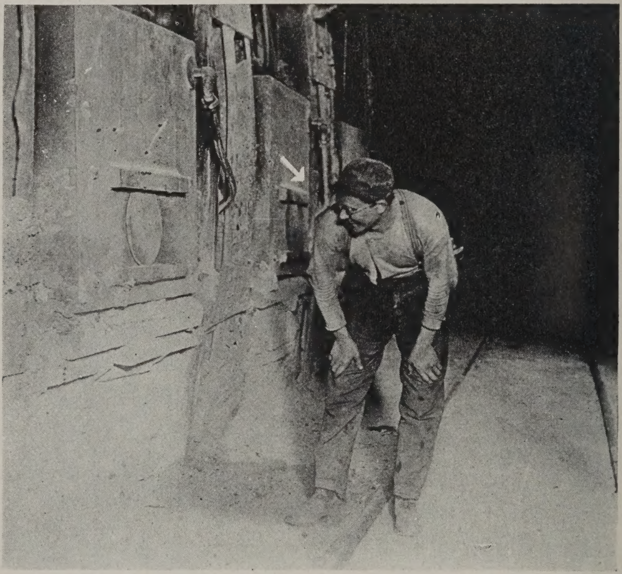


Fig. 94.—Glasses used by open hearth employees to protect eyes while looking in open hearth furnaces.

*Bottlers of aërated waters* and those engaged in their distribution, such as bar-tenders and soda fountain attendants, may suffer injury to the eyes by flying corks or by fragments of glass from the bursting of a bottle. This latter accident may be guarded against in machine bottling in factories by properly placed wooden screens.

As has been aptly put by Gifford[2]: "The largest contingent of the industrial army is made up of agricultural laborers, and in all but the large manufacturing centres the majority of serious eye accidents occurs in this class. As might be expected from the varied activities of the man on a farm, the character of these accidents shows the greatest diversity. These include quite a number of wounds from flying steel occurring while the victims are hammering at their farm machinery. A lot of wire-fence injuries result from running into or from being thrown into the barbs, or perhaps more often from staples flying back when the wires are being taken off of fence posts. A coil of tempered wire is a very treacherous thing. The ends have a way of springing about in an entirely incalculable manner, a fact which every one handling wire should keep in mind. Then come the botanical injuries, of which the typical ones are superficial, but ragged wounds of the cornea

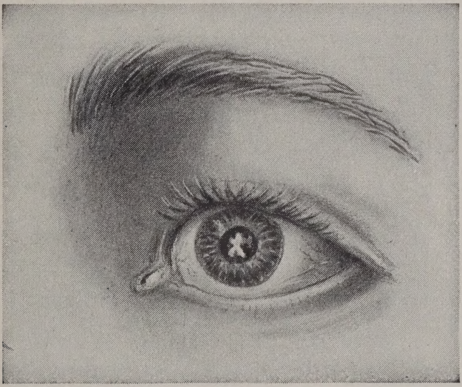


Fig. 95.—Electric cataract.

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[2] "Industrial and Household Accidents to the Eye," Harold Gifford, M.D. Conservation of Vision Series, Pamphlet II, American Medical Association, Chicago.

from blades of corn or beards of wheat, and the more deadly penetration by thorns and weed stubs, which more commonly occur to children. Wood-chopping injuries are also typical and common; the danger to the bystanding child being greater than to the man who wields the ax. Horse and mule kicks furnish a considerable number of the eye injuries on the farm, and this is one of the rare forms of standard eye injury which would generally not be prevented by the use of spectacles. Kicks from cattle rarely injure the eye, on account of the limited vertical displacement of the animals' hoofs.

" A fairly numerous list of eye accidents belong to what may be termed household injuries. An enumeration of some of the most typical of these may do some service in the way of prevention. Chips of steel are not infrequently driven into the eye through the attempt of some householder to open a box by driving a hatchet under the lid with a hammer. This combination of hammer and hatchet is particularly deadly, because, on account of the relatively large mass of the pieces of metal employed, the chips which are broken off the edges fly with great velocity. This danger should be kept in mind, and if it seems necessary to drive a hatchet or ax into a crack, the danger can be averted by interposing a piece of wood between the two surfaces of metal, or by using a heavy stick of wood instead of a hammer. The attempt to drive a nail into a hard plank, on the part of a novice, not infrequently results in the nail flying back so as to injure the eye. Many an eye is lost by the chopper of kindling-wood, one end of the stick struck at right angles being frequently thrown up with great violence. Striking the eye against some projecting corner of furniture while the victim is going about in the dark is a common cause of household eye injury. This is most apt to occur through the patient's stooping over in the dark and bumping his eye on a projecting chair-post. These injuries frequently cause entire loss of sight. Every one going about in the dark should hold the hands six inches or so in front of the eyes. These injuries are also a warning to eliminate sharp corners on tables, as these are of just the right height to put out the eyes of the active child.

" Accidents with household chemicals are not uncommon; a bottle of ammonia, or some strong acid, or a can of concentrated lye being spilled into the eyes while being lifted down from some shelf. Even when chemicals are put away tightly corked the cork frequently goes to pieces under their influence, so that after being set away for some time, some of the contents easily escapes when the bottle is slightly tilted. This should lead to the enforcement of a rule requiring all such chemicals to be put on a high shelf, far back out of the reach of little children."

METHYL OR WOOD ALCOHOL POISONING.—About 30 years ago, under the names of Purified Wood Alcohol, Columbian Spirits, Colonial Spirits, etc., there was introduced a dangerous product of the destructive distillation of vegetable fibre, as a cheap and harmless substitute for ordinary methyl or wood alcohol. Unfortunately, however, the claim of harmlessness was not long maintained, for cases of sudden death as well as of total and incurable blindness began to multiply following the adulteration of various popular medicaments with it. A careful investigation made by several prominent oculists about ten years ago[3] discovered 275 instances of death or blindness (sometimes both) directly traceable to drinking or inhaling the fumes of Columbian spirits or some other form of " deodorized " wood alcohol, such as occur in the adulterated manufacture of Jamaica ginger, essence of lemon, cheap whiskey, etc. In addition to the visual symptoms, there is usually acute abdominal pain, nausea, and vomiting, with symptoms of cardiac depression.

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[3] Buller, F., and Wood, C. A.: " Poisoning by Wood Alcohol." *The Journal of the American Medical Association*, Oct. 1–29, 1904, pp. 972, 1058, 1117, 1213 and 1289.

Poisoning may also occur from inhalation of the fumes of wood alcohol. This generally happens when the exhalations are mixed with rebreathed air, as in varnishing the interior of beer vats, closets, etc. Susceptible subjects may at times suffer from a single rub with alcohol containing the deodorized mixture. Manufacturers of wood alcohol should be compelled by law to so label their products that even the most ignorant should learn of its poisonous character, but better still, its use should be prohibited (Fig. 96).

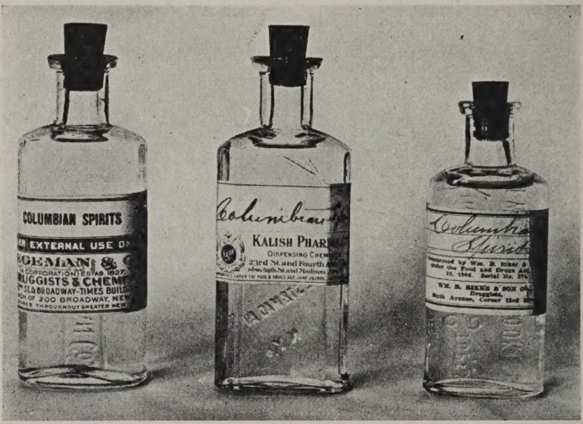

FIG. 96.—Three bottles containing wood alcohol sold by druggists in New York City.

So great is the danger to life and sight from wood alcohol, that it would seem only sane to prevent its manufacture by law, especially as we now have "denatured alcohol," a grain or ethyl alcohol which by its cheapness removes any excuse for the use of the poisonous methyl alcohol. The admixture of various ingredients to denatured alcohol renders it unfit for drinking purposes, but does not destroy its value for domestic consumption or for the purposes of commerce.

Lead Poisoning.—On account of the diversified use of this metal, poisoning from it is not uncommon. Perhaps house painters working with lead paint suffer more frequently than others, but printers handling type are affected by it, as well as employees in lead factories of various kinds. Hair dyes containing lead may evoke symptoms, and seamstresses, from biting off thread which has been weighted with sugar of lead, may also be affected. Children have been known to develop lead poisoning by sucking their fingers after handling fragments of wood upon which the paint which formerly covered it had become disintegrated by exposure to the weather. Ordinarily lead colic and other symptoms of poisoning by the drug precede those of sight, but loss of vision leading in some cases to total blindness may be the first sign. Generally prompt and efficient treatment will accomplish a cure.

Illumination of Workshops.—An indirect, though probably a not infrequent cause of accidents in our factories, is improper lighting of the workrooms. In many establishments the lighting is so insufficient or the lighting fixtures so badly placed, that workmen are either unable to see the dangers which beset them, or their eyes, weakened by the glare of unprotected lights, become incapable of properly fulfilling their functions.

Dr. Nelson M. Black, of Milwaukee, who has made an extensive study of factory illumination, says in this connection: " Factories should be well lighted, first because poor lighting injures the eyes, and second because poor lighting detracts from the earning capacity of the workmen and is an extravagance. Good lighting is economical. Superior work can only be accomplished under good lighting conditions, with which vision is preserved, health is conserved, and factory output is increased from 8 to 15 per cent. Accidents are much less likely to occur. The saving produced by good lighting will pay many times over the cost of the installation of good lighting facilities. The maximum number of accidents occur during the time in which artificial light is used. A well-lighted factory is more productive than a poorly lighted one. Bad lighting is detrimental to eyesight and health. It is an extravagance that factory owners can not afford."

The illumination of all rooms should be uniform and as devoid of shadows as possible. Ordinarily the system of indirect lighting which has so many admirable features, is unadapted to this kind of illumination, as the ceiling and walls of factories are necessarily darkened by smoke and dirt and there is no reflection of the rays of light. Some steady and sufficient form of direct lighting is therefore indicated, and an overhead system which throws a diffuse light upon all the machines is preferable to one which has for its object the illumination of single lathes, wheels, etc.

*To prevent and minimize the danger of ocular injuries* occurring in industrial occupations, several essentials must be emphasized. In the first place, it should be the duty of the employer to install in his workplace every form of safety device which is on the market and which is adapted to the peculiar form of his industry. Proper goggles should be furnished to the employees and a sincere and active campaign of instruction instituted in the works, to instruct and demonstrate to the workmen, the various dangers to which they are subjected, and explanation and reasons given for the safety devices which have been installed. An efficient first aid service should be created, and so far as the eyes are concerned, workmen should be absolutely prohibited from offering any aid whatsoever in case of injury. Too many eyes are lost in consequence of well-intentioned though misdirected attempts at removal of chips and cinders by "handy men" about the shop. The author is convinced from a long experience in treating workmen's eyes, that dirty toothpicks and ends of matches, rusty pocket knives, etc., are responsible for many hundreds of blind in his own State alone.

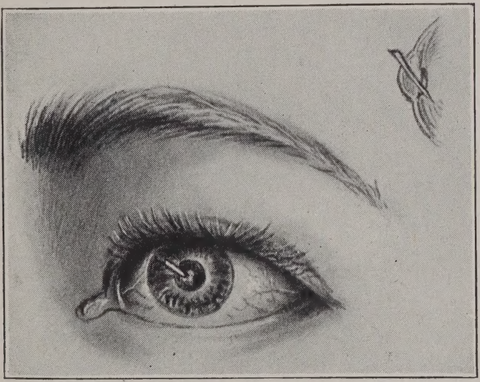

FIG. 97.—Steel chip in lens.

In case of injury a protective bandage should be applied and medical aid sought at once. In the proper cleanliness of the hospital, with its manifold appliances, the skilled physician will detect that the chip which the workman had thought had only grazed his sight or had dropped from the eye entirely after inflicting a slight wound, has in reality entered the globe (Fig. 97). Under X-ray exposure, the chip is located, a magnet applied, the foreign body removed and the eye saved. How different from the

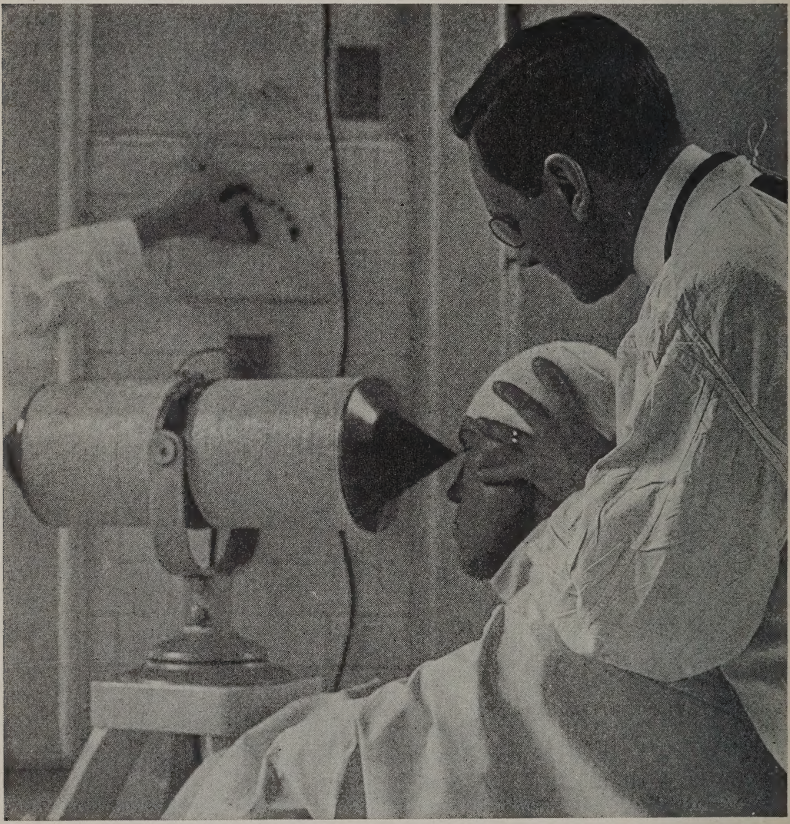

FIG. 98.—Patient in position before giant magnet.

fate of an eye that has been scraped by a rusty knife by a comrade, allowed to become infected, and is lost in a few hours from suppuration (Figs. 98, 99, and 100).

Placards graphically describing the dangers of injuries to the eyes in the various occupations in which they are engaged, printed in the languages of the workmen, should be hung in prominent positions in the works. In addition to these sources of information, the foreman or others in authority should give explanatory and admonitory talks to the workmen at frequent intervals, and every effort should be made to acquaint them with the danger of their work.

With the employer thus engaged at no little cost and annoyance to himself to safeguard his employee, it seems but just that the workman should willingly coöperate to the best of his ability and avail himself of the safeguards which have been provided for him. Indeed, the exigencies of the situation seem so great, that it does not seem unreasonable to attach some penalty in the event that proper treatment is refused or postponed.

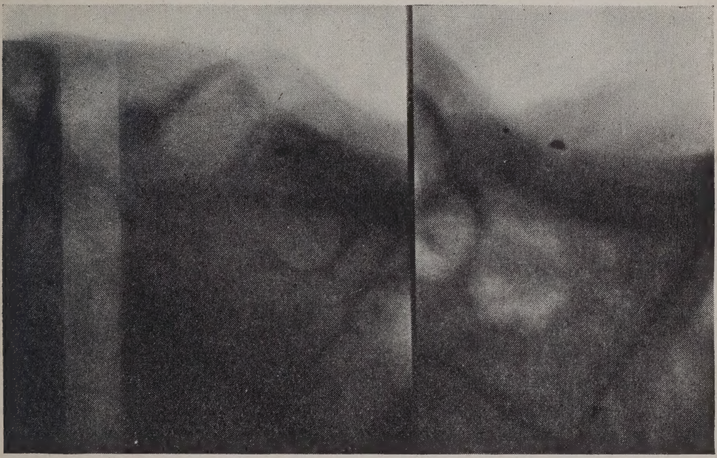

Fig. 99.—Skiagraph showing foreign body in eye.

This would appear to be especially proper in the matter of wearing *goggles,* for the usefulness and effectiveness of this simple device to protect eyesight has now been proven beyond gainsay. Thus the American Car & Foundry Company has proven that the use of goggles has

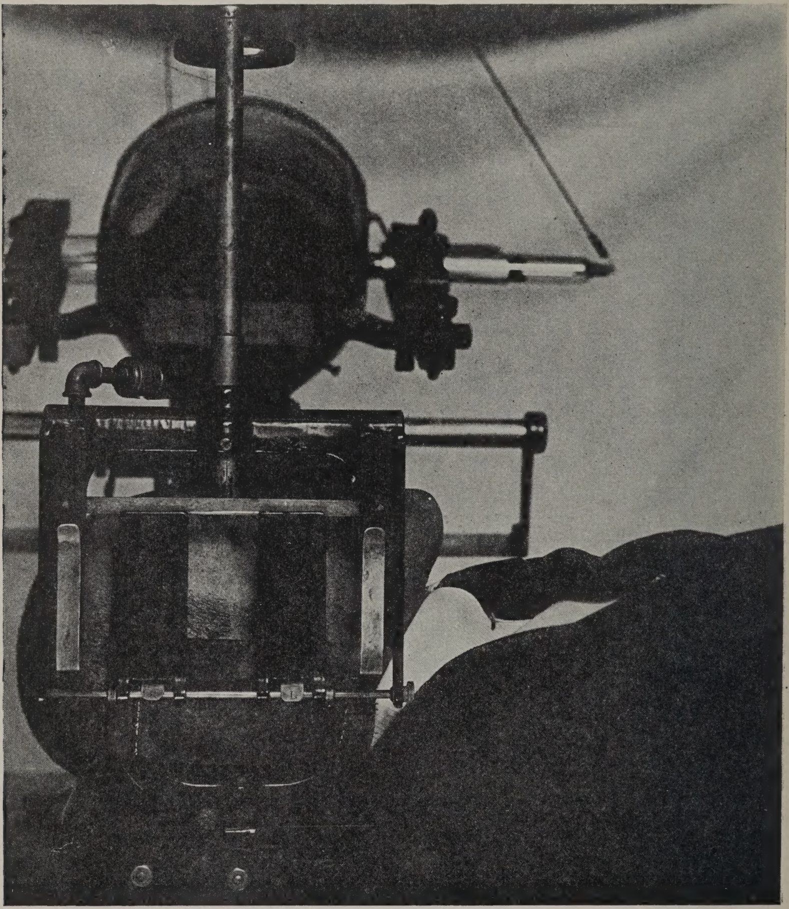

FIG. 100.—Taking X-ray for supposed foreign body in eye. Head of patient in X-ray machine.

reduced accidents in their plant seventy-five per cent. It is argued by some that the wearing of goggles in the event of accident only jeopardizes sight the more, on account of the liability of injury to the eyes from the broken glass of the goggles. As a matter of fact, however, this apparent danger is without foundation, as may be judged by the following evidence. There has not been a single case of injury to the eyes from broken glass since goggles were introduced into the shops of the New York Central Railroad. The American Steel Foundries Company collected 94 pairs of goggles, all with lenses broken from flying chips of steel from their works during a period of 3 months, and in every case the eyes had escaped injury. Had the goggles not been worn, some of the eyes at least would have been lost. In another large steel foundry where spectacles have been worn since 1911, 48 pairs of goggles were collected in one month with lenses broken by flying pieces of steel; 297 pairs were gathered among the several foundries covering a period of six months. During this entire period not one serious eye accident occurred.[4]

Furthermore, in an experience of nearly 25 years, during which the author has treated many hundreds of eyes injured in industrial establishments, chiefly in his service at the Wills Eye and Howard Hospitals, of Philadelphia, he does not remember to have seen a single eye injury from a broken goggle, nor can he recollect having observed similar accidents in the practice of any of his colleagues. Manufacturers of goggles are exceedingly careful to obtain a proper tensile strength of glass and frame. The author is informed, for example, that one of the tests applied consists in dropping a hardened steel ball five-eighths of an inch in diameter, 20 inches from an electric magnet directly upon the surface of the lens, without permitting the latter to rest on any support other than its own frame. The lenses subjected to this test will withstand 35 blows of this kind without breaking, and the construction of the frame is such that in the event of a breakage occurring, the frames tend to push the broken glass away from the eyes instead of allowing it to be pressed in.

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[4] This information was derived from a statement submitted to the author by the National Association for the Prevention of Blindness.

The perfect goggle has not yet been made. It is true that there are a large number of quite satisfactory goggles on the market, which serve the purpose admirably of protection against such accidents as are caused by flying fragments of steel, etc., for all that is necessary under such conditions is a glass of sufficient strength to resist the impact of the foreign body, and wire or leather-screened sides with small apertures provided permitting of some circulation of air, to prevent the entrance of chips from the side. To save the eyes from injury from chemical accidents and those from molten metals, greater protection is necessary, and some form of transparent medium other than glass which will not become fogged or steamed when subjected to heat and gaseous fumes.

A special form of goggle is necessary when the eyes are exposed to the action of intense heat and light rays, such as occurs in oxy-acetylene welding, etc., on account of the injurious effect not only of the heat, but also of the ultra-violet rays generated in such processes upon the eyes. This has been accomplished in the past by the use of glasses that absorbed the infra-red or heat radiations. The objections to this method are—first, that it has been found impossible to make a glass that would absorb sufficient of the dangerous infra-red or heat radiations at one end of the spectrum and the ultra-violet or chemical rays at the other without cutting down the useful and harmless visible light to such an extent that it was extremely difficult for the workman to see his work; second, that the glass by absorbing heat radiations soon becomes intensely hot and then gives out heat radiations itself, thus defeating the object in view.

Quite recently, Professor Pfund, of Johns Hopkins University, conceiving the idea of getting rid of the infra-red or heat radiations by reflection, devised the lens which bears his name and which is made as follows: A flat piece of Sir William Crookes, or other glass of like nature, is coated with an almost infinitely thin layer of 22 karat gold. This gold layer being extremely delicate is protected by a flat piece of hard white crown glass. According to Professor Pfund, the action of the combination is as follows: all of the radiations, except the extreme ultra-violet, pass freely through the hard white crown glass. Encountering the gold layer, the ultra-violet and visible radiations up to about the middle of the red, pass without difficulty between the little particles composing the gold atoms. At about the middle of the red the light waves become too long to pass between these little particles and rebound or are reflected. Thus half of the red and practically all the infra-red or heat radiations or waves are reflected or thrown back. The ultra-violet and visible radiations or waves which have passed through the gold layer encounter the Sir William Crookes glass, which allows the visible light to pass freely but absorbs the ultra-violet. Thus we have disposed of the infra-red or heat waves by absorption, and have passed the visible. This visible light can be regulated by varying the thickness of the gold coating. As regularly made the coating is of such thickness as to pass 25 per cent. of the visible, but, if necessary, can be made to pass 75 per cent. of the visible without seriously cutting down the efficiency in the infra-red or heat end of the spectrum. As regularly made it refracts 98 per cent. of the heat and is claimed by Professor Pfund to be at least twenty times as efficient as the best of the old style protecting glasses for the same transmission in the visible spectrum. Proof of the practical value of Professor Pfund's glasses still awaits, the author believes, practical demonstration.

According to Dr. Nelson M. Black, of Milwaukee, who has long been interested in this subject: " Glass in which the color tends toward a yellow or yellowish green affords the greatest protection from harmful rays. Such glass is found on the market under the name of amber, euphos, fieuzal, akapos and noviol glass. Even this glass must have added to it, in the process of manufacture, a dark smoked tint to reduce the intensity of the glare in order that it may be used with comfort.

" Deep red glass is an effective protection against dangerous light and is in general use in many industries. It is usually combined with yellow, blue, or green and blue glass. The objection to such a combination is the inability to distinguish details and to see to get about, also the increased weight caused by using two or more pieces of glass."

# CHAPTER XVII

## EFFECT OF CERTAIN BEVERAGES AND DRUGS

The eye is susceptible to the action of a number of poisons, which have been considered elsewhere, but there are other substances not usually considered to be poisonous which are in common use as stimulants and which may at times exercise a most deleterious influence upon the eyes. These are tobacco and alcohol.

Tobacco.—That not all users of tobacco suffer from their eyes is apparent, as the use of tobacco is widespread and ocular complications from the habit are but rarely met with. Yet the experience of every eye surgeon is full of instances where the abuse of tobacco has seriously impaired sight. For this unfortunate occurrence several contingencies are necessary. First, adult life; secondly, the absorption into the system of a large quantity of nicotine, either by smoking or chewing or taking snuff to excess, or by the prolonged handling of tobacco by workers in the weed. A third factor of disturbed digestion, usually as an indirect consequence of tobacco abuse and not infrequently of an associated too free use of alcohol, is also not infrequently present.

The quantity of nicotine necessary for absorption before tobacco blindness or tobacco amblyopia, as it is called, manifests itself, varies very greatly in different individuals. Many escape who must be saturated with the poison, showing that the degree of tolerance of tobacco varies in different individuals. Undoubtedly, as has just been suggested, the state of the general health has much to do in maintaining this tolerance, large quantities of cigars being consumed without provoking any symptoms, until a shock or prolonged mental strain or other derangement of the vital processes occurs, when the visual disability at once manifests itself.

The symptom first noted is usually an increasing difficulty in reading. Soon not only the type appears blurred, but distant objects as well appear fogged, the cloud being always densest between the eyes and the object regarded. The recognition of color is affected and those engaged in occupations in which the recognition of color is requisite, such as railroad men and pilots, are no longer able to discriminate between red and green. Undoubtedly a number of marine and railroad accidents have been caused by this interference with the color sense, the affection coming on so insidiously that the mariner or engineer who has previously had no difficulty in recognizing signals and has successfully passed color blind tests has no suspicion that his ability to discriminate between the colors of the signals has been impaired.

Most poisons have a selective tendency in their effect upon the structures of the body, and nicotine, in pursuance with this general rule, damages those fibres of the optic nerve which are connected with the macula lutea in the retina, which will be remembered to be the seat of direct and most acute vision, other portions of the nerve and retina escaping. If the abuse of tobacco is persisted in, total atrophy of these fibres follows and useful vision is lost.

The prevention of tobacco blindness lies either in totally abstaining from the use of tobacco or in moderation. There are those, and perhaps this is true of the majority, who would be far better off physically if they did not use tobacco in any form. Few gain the pleasure and solace from its use which they crave and expect, and no one can truthfully assert that tobacco is in any way a help to health. The custom of using tobacco, however, is so widespread that it is unlikely that hygienists will make much headway in their efforts at its control by preaching abstention and must be satisfied with the half-way measure of moderation. But as so often happens, what is moderation for one is abuse for another, so that any attempt at fixing a definite amount of tobacco safe for daily consumption would be futile. Under ordinary circumstances, however, it would appear that smoking three or four moderately strong cigars each day should suffice as a maximum, and if this rule be adhered to it is unlikely that any trouble with vision will result. So much is certain, that once the symptoms of amblyopia from tobacco manifest themselves, there can be no hope of effecting a cure until the use of tobacco has been stopped altogether. Added to this essential, care must be given to the general health, and all other stimulants, such as whiskey, which may act deleteriously upon vision, must be prohibited. After a sufficiently long period has elapsed to permit the tissues of the optic nerve to regain their vigor and to allow for the elimination of the poison of nicotine from the system, it is sometimes safe to permit of a continuance of smoking under strict curtailment.

Alcohol.—Alcohol, and we are now speaking not of wood or methyl alcohol, that form of alcohol which is used in the arts and whose injurious effects upon the eyes we have already noted, but of ethyl alcohol, the essential principle contained in beer, wines, and liquors, and other intoxicating beverages, has a two-fold action upon the eyes. When taken in toxic dose, that is to say, when enough whiskey or beer is imbibed to produce drunkenness, the accompanying double vision and uncertainty of the position of things is induced by the action of the alcohol on the nerve centres controlling the movements of the muscles of the eyes, just as the muscles of locomotion are affected. As soon as the effects of the spree are gone, however, vision clears, and no permanent danger to sight remains.

Steady and excessive drinkers, however, occasionally develop a form of blindness or amblyopia very similar to that which follows the abuse of tobacco; indeed, the two often go hand in hand, for heavy drinkers are often heavy smokers and *vice versa,* for the habitual smoker often craves liquor in some form to stimulate his heart which has been depressed by nicotine. Like the disturbance of vision from tobacco, the cloudiness from alcohol occurs only in those who have long indulged themselves in the excessive use of the stimulant, and usually manifests itself only after the general health has been impaired by their excesses. The same fibres of the optic nerve are involved as in tobacco amblyopia, and the only hope of amelioration is complete abstinence from the use of alcohol in any form.

The avoidance of this form of visual disturbance consists, naturally, in the temperate use of all kinds of beverages containing alcohol, particularly those, such as whiskey and brandy, which contain large percentages of this poison. One attack should determine strict abstinence for life, for a recurrence is more likely than after tobacco amblyopia and a complete cure more difficult to obtain.

TEA, COFFEE, AND CHOCOLATE.—In rare cases, due to the absorption by the body of poisonous substances contained in them, the excessive use of tea and coffee has caused partial blindness. Fortunately, such visual disturbances are rare. More common are those which arise from a general impairment of digestion, in certain individuals who possess what is termed an idiosyncrasy for these substances, and which is seen oftener from drinking chocolate, when certain visual phenomena appear which are akin to those already described under migraine, *i.e.,* flashes of light, motes, half vision, etc. Naturally, individuals with such an idiosyncrasy should abstain entirely from these beverages and the baneful effects from the excessive use of tea and coffee should be combated by temperance in their consumption.

Drugs.—The excessive use of certain drugs may be injurious to vision. Mention can be made here of only the most common. Blindness from *quinine* usually occurs in malarial districts, whose population are accustomed to taking large quantities of the drug without medical supervision. The loss in vision is generally accompanied by other symptoms of quinine poisoning, viz., ringing in the ears, dizziness, fulness in the head and at times stupor or delirium. Blindness may be immediate, or come on gradually. The loss in sight may be so pronounced that not even a flash of light may be perceived when held close to the eyes. At other times, there may be but a moderate obscuration of surrounding objects. After some days or even weeks of blindness, vision gradually returns, though very rarely to anything like full acuity, the field of vision being much compromised by the disturbance of optic nerve and retinal tissues occasioned by the overdose of the drug.

As the toxic dose of quinine varies for different individuals and under various circumstances, no fixed amount can be stated as being fatal to sight; it behooves all, therefore, to be cautious in the amount they consume, and to allow a sufficient interval to elapse to insure the absence of unfavorable symptoms before the repetition of a 5 or 10 grain dose.

Overdose of *salicylic acid,* a drug much used to control rheumatic fever, acts upon the visual apparatus in much the same manner as quinine, though recovery is prompter and permanent danger rarer.

Various *drugs used in the expulsion of worms* from the economy, such as male fern and santonin, the bases of many proprietary worm cures, may also exert a deleterious action upon vision and should only be administered under medical supervision. Permanent loss of sight may follow the ingestion of a poisonous dose of these drugs, being accompanied usually by purging and vomiting.

*Iodoform,* a powder used for antiseptic purposes on raw surfaces, may be absorbed and produce visual disturbances closely akin to those of tobacco. Loss of sight is usually, however, preceded by other toxic signs, such as diarrhœa, delirium, and fever, which should serve as cautionary measures for the withdrawal of the drug.

## CHAPTER XVIII

## COLOR-BLINDNESS

When a beam of light is permitted to pass through a prism its rays are broken up into their component parts, and according to the wave length of these parts, a luminous band or spectrum is formed, which appears to the normal eye to be composed of many colors, namely red, orange, yellow, green, blue, indigo and violet. The red end of the spectrum, corresponding to the refraction of the longest light waves, forms one end, and the ultra-violet or shortest waves, the other end of the spectrum. Color, therefore, as such does not exist in nature, but is a sensation excited in the eye by light waves of different lengths. The inability to distinguish all of the colors in the spectrum constitutes color-blindness.

Although noted a hundred years previously, the first accurate description of this condition was given in 1774 by Dalton, an English chemist, who himself was color-blind, and who published an accurate account of his own sensations. Among other peculiarities, he stated that he could note no difference between the color of a green laurel leaf and that of a stick of red sealing wax. To him the various tints of the rainbow were narrowed down to yellow and blue. Since Dalton's time, numerous theories have been advanced to explain color-blindness, the most important of these being the Young-Helmholtz and the Hering theories.

Color-blindness may be total or partial, congenital or acquired. To those who are totally color-blind, the world appears as though it were tinted with different shades of gray. Total color-blindness is rare, but congenital partial color defect is common, occurring in about 4 per cent. of all males. In women it is rare, occurring in about $^2/_{10}$ of 1 per cent. According to a well-known authority, color-blindness is hereditary and is attached to certain families; it may not be found in one generation, but reappears in the next; all children will not be affected, the girls especially escaping; when several children are affected it is traceable to the mother; the kind and degree will be the same for all the cases in the family. In total color blindness, consanguinity in the parents has been traced in 12.5 per cent. of the cases. Partial color-blindness may vary greatly, but the inability to differentiate between red and green is the most common.

Acquired color-blindness may attend any disease within the eye which causes retinal change or interferes with the proper conduction of impulses from the retina to the visual brain centres. The most common cause of acquired color-blindness is disease of the optic nerve due to the immoderate use of alcohol and tobacco, a fact of great significance, as will be presently recognized.

It is essential in all cases of color-blindness that a differentiation should be made between the acquired and congenital variety, for the first is amenable to treatment, the latter incurable. The diagnosis is, as a rule, readily made, for in the acquired form a searching examination will find evidence of the existing disease within the eye and visual acuity will also be lessened, whereas in the congenital form, visual acuity is unaffected and the eyes themselves are free from disease.

Color-blindness is of great significance, for it disqualifies for all occupations in which a proper discrimination between colors is an essential. This includes many railroad employees, all naval and marine officers, pilots and certain classes of seamen, and all occupations in the arts which require mixing pigments or matching colors. As a rule, even those who are totally red-green blind are unaware of the existence of this defect in their vision, and it is often only after a most searching test that the lack in color sense can be demonstrated. Although investigations and tests had taken place at an earlier date, it was not until 1875 that Holmgren, a Swedish savant, instigated by a serious railroad accident, perfected a method by means of which deficiencies in the color sense might be detected. This test, which is still in common use, determines the ability of a person to match various colors, a series of colored yarns being used for this purpose. The set of worsteds employed for this purpose consist of (1) three chief *test colors, i.e.,* a pale green, a light pink and a bright red, (2) a series of *match colors* of lighter tints and hues which the color-blind are apt to confuse with the test colors. The person under examination is given one of the chief colors, and told to pick out from the mass of worsteds spread out before him, all colors which match it. The man with normal color sense will have no difficulty in discriminating, but the color-blind person will confuse red with greens and will add confusion colors of various tints, such as drabs, grays, browns, etc. The wool test is usually supplemented by a lantern test, the lantern used for this purpose being constructed in such a manner that a disc upon which are mounted the various colors used in railroads and the marine, *i.e.,* white, red, green, and blue, may be superimposed over the light of the lantern in rapid succession. As it has been found that the color-blind are frequently able to differentiate between colors by their different intensities of brightness, the apparatus is so arranged that a series of ground and smoked glasses may be used to diminish the brilliancy of the various test colors. The lantern is placed at 20 feet from the observer, in a darkened room, and the observer required to recognize and name colors of a size which subtend a visual angle of 1 minute at that distance (see p. 19).

Those with color-blindness, acquired from the abuse of alcohol and tobacco, as well as from other causes, may at times recognize colors correctly, provided the object upon which the color is exposed is sufficiently large, but are never able to meet the most stringent requirements of the lantern test. Candidates for services rendering the testing of their color sense a necessity are often dissatisfied with the Holmgren test, as they imagine failures are due to their inability to name the various colors exposed to them, though the test actually makes no such demand. They are, as a rule, however, satisfied with the results obtained from the more familiar exposure of the various colored lights in the lantern.

# CHAPTER XIX

# THE BLIND. BLINDNESS FROM AN ECONOMIC AND SOCIAL POINT OF VIEW. THE EDUCATION AND EMPLOYMENT OF THE BLIND

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In the preceding chapters all the emphasis has been placed, as it should be, upon doing everything possible to conserve vision. But when everything known to science has been done to prevent blindness, disease and accident will still take their toll and it will be the sad duty of the oculist to tell the fond mother that her little one will never see again; or perchance a strong man that he must prepare himself for oncoming blindness. The purpose of this chapter is not to minimize blindness—the loss of sight is always a calamity—but to bring a message of hope and cheer to those who must and can learn to live useful lives in spite of blindness. We shall learn that total blindness need not, does not, mean total despair.

Causes of Blindness.—As the causes of blindness have been so fully considered in preceding pages, mention need be made here of only one of the most common causes of blindness in those of school age, *i.e.*, between the ages of five and twenty. The most prolific of all the causes of blindness in children is that scourge of infancy, *ophthalmia neonatorum* (babies' sore eyes), which does its damage usually within three or four days after birth. The National Committee for the Prevention of Blindness found that of

3334 pupils enrolled during the school year 1914–15 in 30 residential schools for the blind, 740, *i.e.,* 22 + per cent., were the victims of ophthalmia neonatorum; and that 91 of the 602, *i.e.,* 15 per cent., of the new admissions in 28 of these schools were blinded by this disease. It made blind 71 of 200 (35 per cent.) of the pupils enrolled in the Philadelphia school December 1, 1916, and was the cause of blindness of 27 per cent. of all pupils enrolled during the past 25 years. A conservative estimate is that one-fourth of all the children who reach our schools for the blind are victims of this dire disease. And the horror of it all is that blindness from this cause is almost wholly unnecessary; for it is preventable in almost every case. Prevent blindness in this one-fourth of the pupils enrolled during the last school year (1915–16) and we could close one-half of the smaller residential schools for the blind in the United States. Stop blindness from this one cause and the reduction in the number of pupils would enable us to close the schools supported by the following States: California, Colorado, Connecticut, Florida, Georgia, Idaho, Kansas, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Carolina, South Dakota, Utah, Washington, West Virginia, Wisconsin, and Vermont. And as the annual per capita cost of educating a blind child in a residential school is now easily $350 in excess of that of educating a seeing child, the annual saving to the tax payers of the United States in the case of those children who are unnecessarily blind from this single cause would be at least $430,000.

NUMBER OF BLIND PERSONS.—No accurate statement as to the number of blind persons in any unit of government can be made. That such information is lacking when so much attention is given to the collection of statistical data concerning every sort of enterprise is due to two principal causes: the lack of a generally accepted definition of blindness and of an accurate method of enumerating our blind population. According to the exact and scientific definition of the oculist, only he is blind to whose brain the optic nerve conveys not even the sensation caused by a ray of light. If this definition be accepted, the number of blind is small indeed. But for the determination of such practical questions as education and employment, we must include in any enumeration of the blind those who have light perception, see shadows or have varying degrees of defective vision. There is substantial agreement among oculists that children who possess not more than one-tenth normal vision should be taught by the methods used in the education of the blind; and this definition of blindness is generally accepted by educators of the blind. If blindness be thus defined the number of blind persons will be very much larger and the ratio of the blind to the general population will be perhaps as 1 : 2000. If we accept the figures of the United States census of 1910, the ratio for the entire country is approximately 1 : 1600; for the State of Pennsylvania, 1 : 1700.

Classification by Age and Sex.—The New York State Commission on the Adult Blind in 1903, classifying the 6008 persons returned as blind by the United States census enumerators of 1900, found that of each 100 of the blind population 10 were under 21 years of age; 23 were between 21 and 50; 14 between 50 and 60; and 53 over 60 years of age. Other studies seem to warrant the general statement that in the United States of every ten blind persons one is under 20, four are between 20 and 60, and five are over 60 years of age. Of every 100 blind persons approximately 55 are men; 45 women.

## PROVISIONS FOR THE EDUCATION, EMPLOYMENT AND CARE OF THE BLIND

In whatever phase of work for the blind he may be interested, every American returns from a study of the provisions for the blind of Europe with the feeling that the lot of the blind in America is far better than that of the blind in European countries. How varied and how generous these provisions are, a mere enumeration of them will show. For blind babies and children too young to attend school, nurseries; for children of school age, residential schools and classes providing for the co-education of blind and seeing; for able-bodied men and women of working age, not only working homes where blind men and women are segregated, but State commissions and voluntary associations to aid and encourage coöperative and individual effort with particular emphasis upon keeping blind people in their own homes and communities; for those who desire to read, circulating libraries of embossed books; for the adult blind, home teachers who go from home to home to teach reading and supply vocational instruction; and for the aged and infirm, homes for their care and comfort. While no two States make exactly the same provisions for their blind citizens, there will be found at the close of this chapter a brief but complete statement of all the provisions made by public and private philanthropy for the blind of the State of Pennsylvania.

NURSERIES FOR BLIND BABIES.—In the United States there are at least five nurseries or homes for blind children under school age whose combined capacity is about 125. In addition to these at least six States provide by law for the instruction and maintenance of blind babies either within their own borders in similar institutions for seeing children or outside the State. The normal place for any babe, seeing or blind, is at home with his mother, and no blind child under five years of age should be deprived of such care except for reasons that would obtain with seeing children. These nurseries provide excellent care and training for young children who need them as well as for some who are older but backward or even feeble-minded.

The Education of Blind Children.—It is difficult to say where and when the idea first took root that persons without sight could be educated, but it is certain that it received its greatest initial impulse from the determined efforts in behalf of the blind of a son of a poor French weaver, Valentin Haüy, who had demonstrated by 1785 that the blind could be educated. Haüy's work had a very direct influence upon the beginnings of educational work for the blind of this country. "I am convinced," said Julius R. Friedlander, the first principal of the Pennsylvania Institution for the Instruction of the Blind, "that whenever more extensive experience and a better insight into the ideas of the immortal Haüy, relative to the instruction of the blind, shall prevail, his system will be everywhere introduced."[1] The Philadelphia school shares with the schools of New York and Boston the honor of taking, about 1830, the initial steps to provide systematic instruction for the blind of the United States. The education of the blind, as of all so-called defectives, had its beginnings in private philanthropy, but an appeal was soon made for aid from public funds. Accordingly, it was quite the custom to proceed with a small group of pupils to the capital of the State and there before the law-makers to give an actual demonstration of the possibilities for training those who could not see. Appropriations usually followed such demonstrations. The influence of the undertakings in these three centres of population and culture spread rapidly and the older and more populous States in quite rapid succession provided residential schools for their blind children. To-day there are forty-four residential schools in forty States of the Union which were attended last year (1915–16) by over 5000 students, the combined value of whose plants was stated in 1914 to be $15,224,693.

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[1] An address to the public at the First Exhibition of the Pupils of the Pennsylvania Institution for the Instruction of the Blind, at the Musical Fund Hall, Philadelphia, Thursday evening, November 21, 1833.

All the older schools have passed through the experience of admitting both children and adults, apparently the sole qualification for admission being that the applicant should be blind; but it was early learned that this practice was unsound for moral as well as pedagogical reasons and the almost universal practice now is to admit only children between five and twenty-one years of age who are in suitable physical, mental, and moral condition to profit by the instruction afforded. The average age of the pupils in one modern residential school of about two hundred pupils is less than fifteen years.

The age at admission varies greatly for three principal reasons: the variation in the age at which sight is lost; the ignorance of parents and people generally about provisions for educating the blind; and the reluctance of parents to send their children away from home at a tender age.

Of the 35 new pupils received into the Philadelphia school for the statistical year ending May 31, 1916, 16 were under 10 years of age; 10 were between 10 and 15 years; 7 were between 15 and 20; and only 2 were over 20 years.

The length of time in school likewise varies greatly. Determining factors here are the age of becoming blind, general physical condition, mentality, ambition to learn, and the attitude of the home toward culture. Of 35 pupils discharged from the Philadelphia school for the statistical year ending May 31, 1916, 3 remained less than one year; 9 between two and five years; 9 between five and ten years; and 14 over ten years (Fig. 101).

In a well-conducted modern school for the blind instruction is organized under four principal departments; physical, manual, literary and musical. And their importance is about in the order named.

Physical Training.—The blind child without training is usually anæmic, under-developed, poorly nourished, with flabby muscles and nervous habit movements. If his blindness is the result of disease, his physical stamina may have been lowered so that he is quite content to sit idle in a rocking chair; if, as is more likely, he still retains the desire to share in the play and the varied activities of childhood, he gets small encouragement from his brothers and sisters or from seeing children of the same age—the blind boy or girl does not fit well into the active play of seeing children; he is in the way. As blindness is most prevalent among the poor and ignorant, either because of ignorance or under the stress of poverty parents fail to provide the physical exercise necessary for the child's growth and development; for it is now generally recognized that play and physical activity are fundamental to mental no less than to physi-

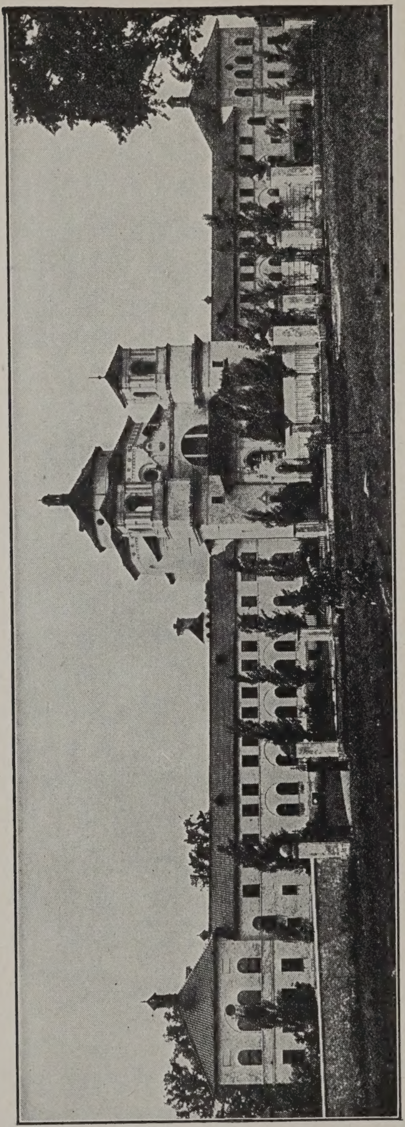

FIG. 101.—The Pennsylvania Institution for the Instruction of the Blind, Overbrook, Philadelphia.

cal growth. And it is not uncommon for a mother to admit that she seldom takes her blind child out with her because " he attracts so much attention."

For these and other equally cogent reasons the first problem in the education of the blind child is his physical development. Accordingly, everything possible in the school regimen is arranged to lay the foundation of his education in the improvement of his physical condition; regular hours for sleep, an ample supply of nourishing food, an abundance of fresh air and sunlight, a liberal amount of prescribed exercise, and sufficient time for free play.

Upon admission his general physical condition is carefully and critically examined by specialists in medicine; the household physician inquires into his general health, the laryngologist looks to the condition of his throat and ears and if he has adenoids or enlarged tonsils they are removed, and the oculist makes a careful examination of his eyes, and if he believes his health or his sight can be improved by an operation he recommends it.

Recognizing its obligation to do everything possible to improve the physique of its pupils, the management of a modern school for the blind endeavors to provide as essential features of its equipment a gymnasium, an athletic field, a swimming pool, and a bowling alley. There is little in the equipment of gymnasium or playground to remind one that the children who use the apparatus are deprived of sight—in the gymnasium, horse, wall machines, parallel, horizontal, and stall bars, trapeze, teeter ladder, giant stride, climbing ropes, horizontal ladder, running track; on the playground, swings, see-saws, horizontal bar, slide, and merry-go-round. The wide cement border will attract the attention of the observant visitor who is paying his first visit to the gymnasium of a school for the blind. In answer to his query he will be told that its primary purpose is to inform the sightless roller-skater or dancer that he is nearing the wall of the room; for the moment his foot passes from the wood to the cement floor he knows that he is in the danger zone and he immediately changes his direction. Incidentally this border is a convenient and safe place for placing the movable apparatus when not in use.

Swimming, always an excellent form of exercise (Fig. 102) is particularly beneficial to the blind in that in most forms it forces the swimmer to throw his head back, thus counteracting the tendency to round shoulders among blind people. Under good instructors every boy who remains in school two or three years and at least half the girls learn to swim, some of them becoming quite expert in the several varieties of strokes, in diving and in swimming under water.

Considerable individuality is shown among bowlers without sight in the manner of getting their direction before throwing the ball; one runs keeping his left hand on the ball rack; another stands still, getting his sense of direction by running his left hand a little way along the edge of the gutter; while a third, given his sense of direction by the voice of the lad at the foot of the alley, seems to need no other guidance. Necessity being "the mother of invention," these boys have given each pin a number, and when the lad who is setting up the pins names the numbers still standing, the sightless bowler knows exactly where he should throw the ball. A record of 222 of a possible perfect score of 300 points made by a totally blind boy is proof that blindness does not bar one from a form of exercise which seems to demand sight.

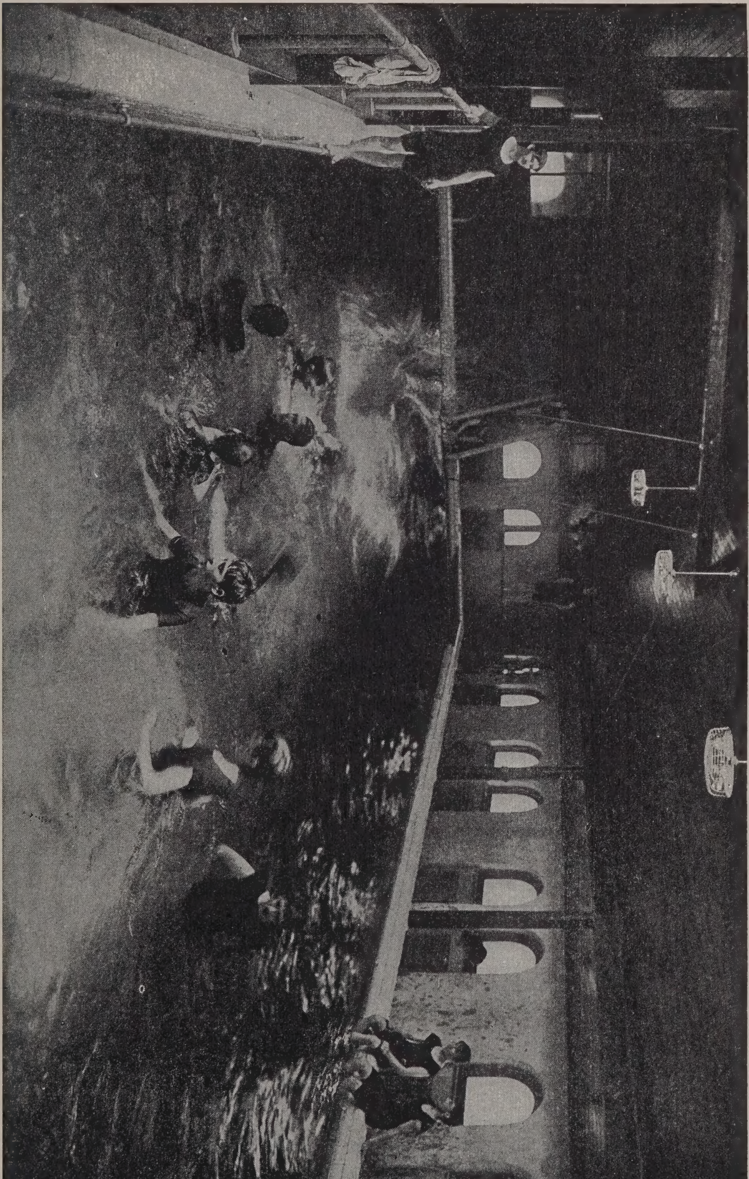

Fig. 102.—The swimming pool—length, 55 feet; width, 27 feet; depth, 3½ feet at shallow end, 6½ feet at deep end. Lined with white tile. The diving board and diving chute can be seen in the background. With few exceptions, all the boys and about half the girls learn to swim while attending school.

On the athletic field some of the activities of seeing boys are equally open to blind boys without any special devices. Among these are the standing broad jump, the standing high jump, three successive jumps, and the hop, step, and jump. Given a free open field, the blind boy can engage in a contest in the running broad jump, his distance being measured from his " take off " to his landing point. A totally blind boy can put the shot and throw the hammer almost as well as the seeing lad of equal age and physical development, the only special device necessary being a half-circle made of wood. It is manifestly impossible for a totally blind boy to engage in a foot race without some device by which to give him his direction. The apparatus that has been devised to make this possible is about the only special device necessary in equipping an athletic field for sightless boys. " The idea of this was borrowed from pictures contained in the reports of the institution in Sydney, New South Wales, and in Edinburgh, Scotland. A three-strand twisted wire cable, as light as is consistent with strength, is stretched breast high between well guyed end posts one hundred and ten yards apart. The little sagging towards the middle is of no consequence. The runner holds in one hand a wooden handle attached by a short flexible chain to a ring on the wire. As he runs the ring slips along and both the feel and the sound it gives enable him to hold his course. So far so good; but how to afford a proper stop at the one hundred yards mark was not ascertained until we had stretched across the track at this place a fringe made of hammock twine to strike the runner in the face, much as the low-bridge indicator does the men standing on top of moving freight trains. This fringe stop, which is entirely satisfactory, covers the two parallel cables of our running track. Starting as they always do from the same end, blind boys can practice running as much as they please; but in all real racing, one instructor starts a pair by pistol shot while another instructor, standing at the one hundred yards mark, times them with a stop watch" (Figs. 103 and 104).[2]

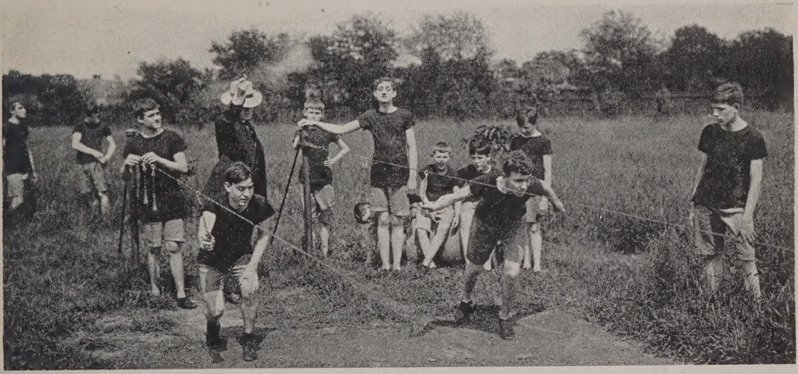

FIG. 103.—One hundred yard dash. Start.

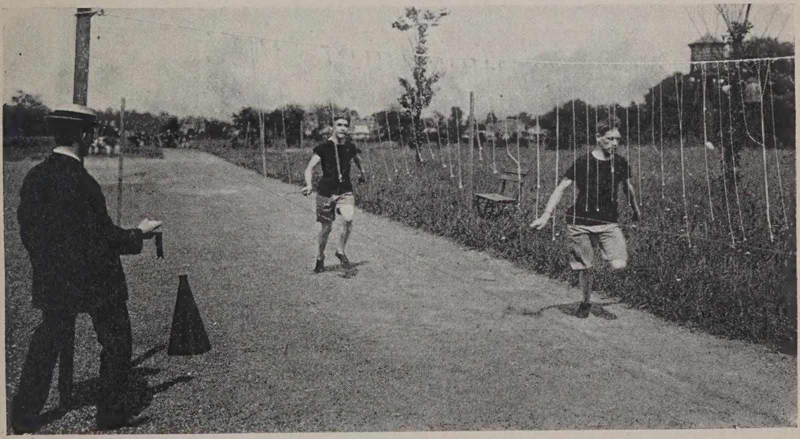

FIG. 104.—Finish.

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[2] Edward E. Allen in the Seventy-fourth Annual Report of the Pennsylvania Institution for the Instruction of the Blind.

Blind boys get a great deal of sport and much pleasurable exercise from a modified form of *football.* To introduce the element of competition they usually choose sides, seeing to it that each team contains an equal number of totally blind boys and at least one with some sight. When it has been determined by lot which side shall " kick off " from the centre of the field, the efforts of each team are directed toward kicking the ball over the goal of the opposing team. To prevent the ball from passing over its goal the team depends chiefly upon their team mate who has sufficient vision to see the ball when in motion, although the captain has directed his sightless team mates to stand at possible strategic points with the hope that the opposing player who, four chances out of five, is unable to see where any member of the rival team is standing, will chance to kick the ball against one of them who thus contributes what he can toward the stopping of the ball. But the totally blind player contributes his major share to the team work by kicking the ball which he oftentimes does as well as, and sometimes better than, his team mate with some sight. The number of times each team kicks the ball over the goal of the other, within the time limits, determines the final score.

THE TRAINING OF THE HAND.—As the hand must do duty for the eye, particular emphasis is laid at all times upon the training of the hand. This training is begun among the younger children by making large use of the kindergarten occupations. *Clay modeling* and *drawing,* which blind children do with upholsterer's brass-headed tacks on " cushions " filled with excelsior and covered with denim, are particularly valuable because they enable the child to *express* his ideas of objects which he has studied;

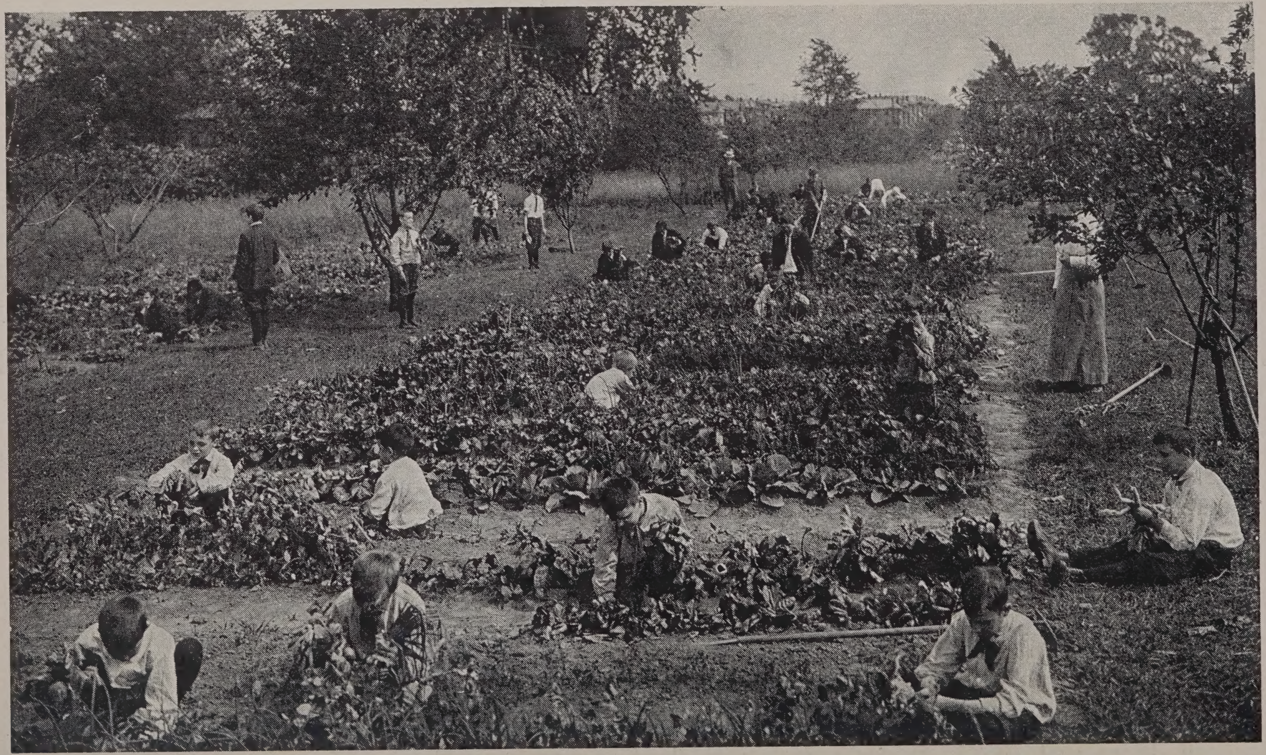

Fig. 105.—School gardens in June. Before leaving for their summer vacation, pupils can enjoy the lettuce, radishes, scallions, peas, beans—the early and quick-growing vegetables: corn, tomatoes, pumpkins—the slow-growing vegetables are ripening as they return in September.

*paper folding* and *cutting* patterns with blunt pointed scissors; *weaving* with strips of wood about three-eighths of an inch wide with half-inch skirt braid as warp; *stringing* kindergarten wooden beads on heavy shoe laces followed by the stringing of nature materials, such as cranberries and various kinds of garden seeds (after soaking in water); *sewing* with shoe laces through holes one-fourth inch in diameter, followed by the use of coarse blunt worsted needles with large roughened holes through heavy cardboard—an unconscious but valuable training for finger reading; *raffia* for winding over a firm foundation, making such objects as napkin rings and picture frames; and *reed basket making*, made possible for younger children by the introduction of wooden bottoms for baskets and trays—these are the principal occupations by which the hands of the little blind child are trained during his first years at school. To work of this kind, so fundamental in all his education and so vital in his subsequent employment in the development of facility in the use of his hands, he should devote at least one-third of his time in the school-room (Fig. 106).

With this foundation the blind girl begins her course in the manual arts, which includes hand-sewing, knitting, crocheting, and machine sewing. In some schools girls are taught to cane chairs with the double purpose of securing a greater variety of manual occupation and of utilizing it as a means of contributing towards their livelihood after leaving school; for under favorable conditions blind women have been able to earn very creditable amounts from this handicraft. Some learn to weave rag carpet. In a few schools the course in manual occupations includes also working in wood with the simplest tools. No course in

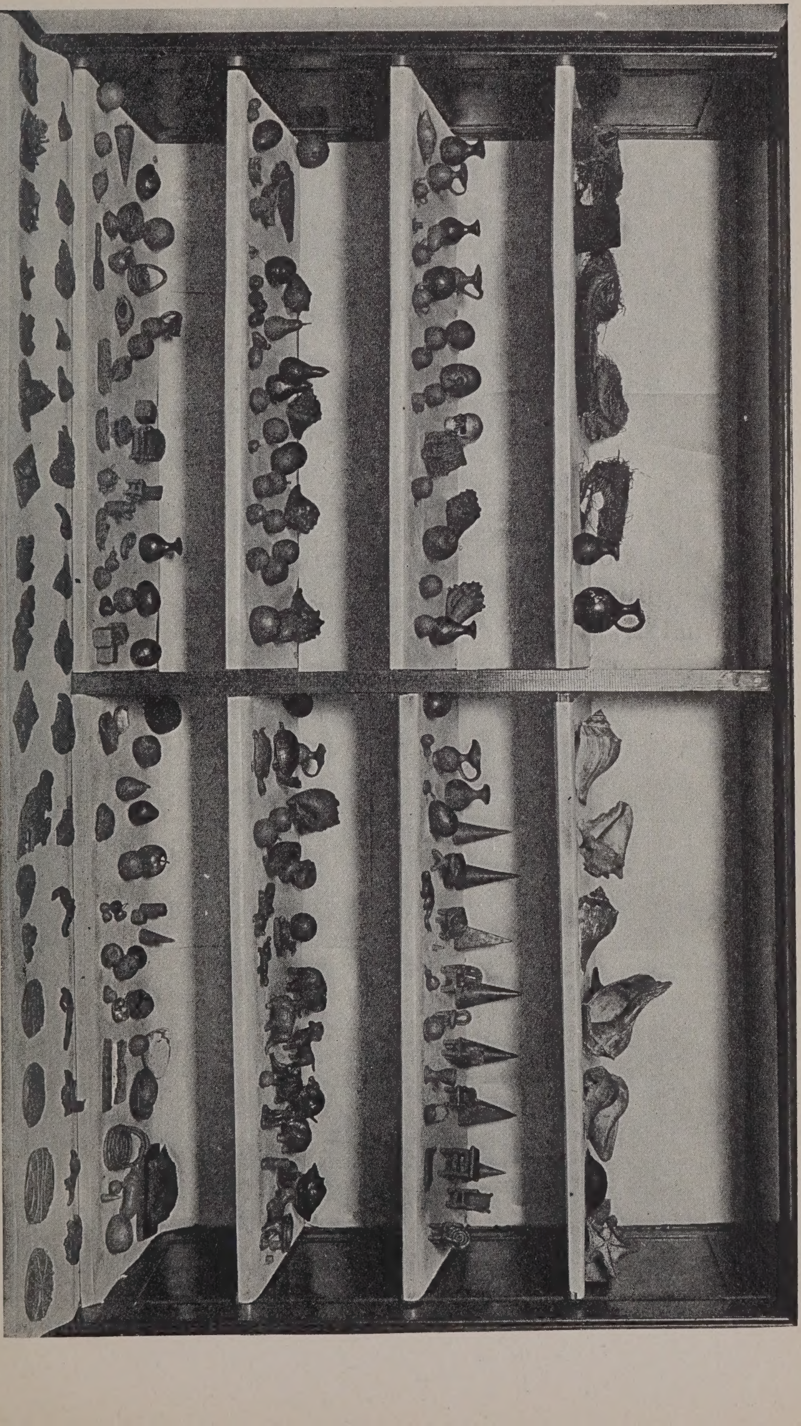

Fig. 106.—Modeling—the work of boys of the second, third and fourth grades. In some instances models and objects modeled can be seen side by side. Can you tell which is the model?

manual training for blind girls is complete without instruction in the elements of domestic science or home keeping. Where the school is built on the cottage plan, the ideal course combines the theoretical instruction of the classroom with the practical application of such instruction in the necessary daily routine of the life in the cottage (Fig. 107).

For the training of the hand of the boy a thorough course in manual training is provided of which the chief element is working in wood, or wood-sloyd. This course should extend over at least four years of his elementary course. By it he is laying the foundation for his life career; these are the years during which his muscles are most responsive to training; no subject in the school curriculum is of more importance to his success in life. But the training of the hand must not cease after four years of manual training. Our problem is to provide sufficient variety of training to hold the boy's interest that he may continue to develop facility with his hands. So caning is introduced at the appropriate time and instruction in this manual occupation proceeds simultaneously with wood-sloyd. By this time his capabilities along manual lines are sufficiently known to guide the teacher in planning his subsequent hand training. If he has good use of his hands and has shown in his general musical training some ability to judge pitch, he is given a trial at piano tuning. If he lacks ability along either line, he should not undertake to prepare for tuning. The usual manual occupations remaining for him are weaving rag carpet and rugs and the making of brooms.

LITERARY DEPARTMENT.—From what has been said it should now be quite evident that the foundation of a blind

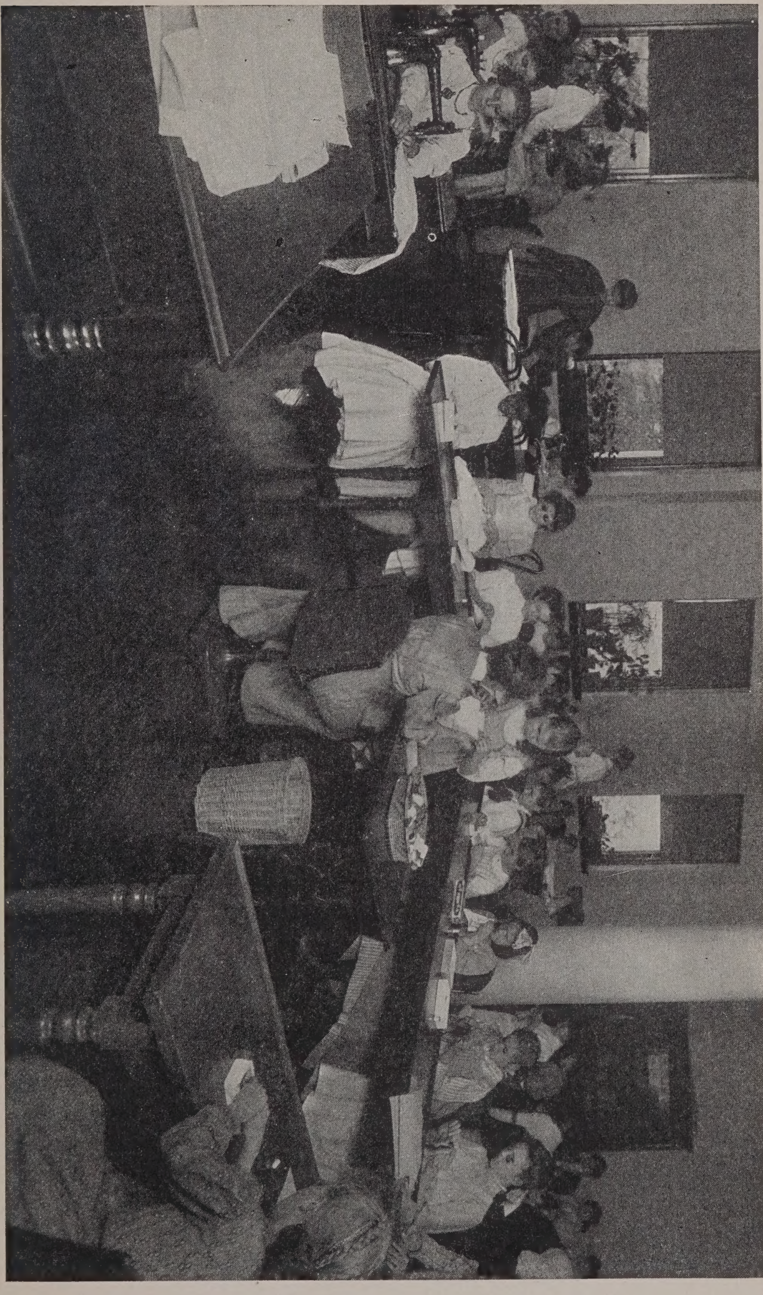

FIG. 107.—The workroom. Knitting, crocheting, hand and machine sewing, darning, and reed and raffia basket-making are all taught in this room by three teachers, two of whom are totally blind.

child's education must be laid in the upbuilding of his body and in the training of his hand. But an essential element in any school is a course of study and this exists in one form or another in all schools for the blind. Instruction is usually provided in nearly all subjects taught in the public schools through primary, intermediate and grammar grades, several schools maintaining kindergartens. Most schools provide instruction in from one to four years of high school subjects. A few of the more capable pupils are encouraged and assisted in every way possible to supplement the education obtained in a school for the blind by continuation courses at normal school, college, university, or school of theology.

*Reading.*—As an instrument for the acquisition of knowledge through books, the ability to read is a prime essential. Valentin Haüy " was the first—of whom we have any record—who conceived the idea of systematically teaching the blind to read by means of raised characters.[3] The story of the way in which Haüy was aroused to provide for this need of the blind is so interesting and instructive and the results of his efforts for them have been so far-reaching in their effects that it is reproduced here.

" In 1771 St. Ovid's Fair was the chiefest popular attraction. Daily at this time when the crowds were greatest, one of the booths had been mounted by a certain Valindin, an impressario of genius after his style, whose success had marked these public shows. Valindin had gathered together a number of blind men, whom he had given in charge of a crowd of rowdies. These fellows were so enthusiastically enjoying the sport that they would have demolished the booths in their exuberance, so that it became necessary to organize a cordon of guards for protection. Valentin Haüy saw the exhibition. He followed the throng and here, depicted by himself, is the scene which he beheld and the impression which it made.

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[3] " History of the Education of the Blind," by W. H. Illingworth, p. 5.

" 'In the month of September, 1771, they had placed in a café at St. Ovid's Fair, six men, chosen from those who were reduced to the humiliating necessity of begging their daily bread; and to attract attention and to excite public sympathy, they employed an instrument which if the hearer were gifted with a musical ear, and even more if he had a tender heart, would drive him from the inharmonious sounds, that were designed to gain a reward of talent. These men had been grotesquely costumed in robes and long-pointed hats. On their noses they had put huge pasteboard spectacles without glasses. Placed before a desk on which were music and lights, they executed a monotonous chant in which the tenors, the bases, and the violins all took the same part. There was nothing to palliate the insult that they had put upon these unfortunates, who were surrounded by emblems of the grossest ignorance, as, for instance, in placing behind their leader the expanded tail of a peacock, and on his brow the headdress of Midas.

" 'Why was it that a scene so dishonorable to humanity did not perish the instant of its conception? Why was it that poetry and picture should lend their divine ministration to the publication of this atrocity? Ah! it was without doubt, that the scene reproduced before my eyes, and carrying into my heart a profound sorrow might inspire and arouse my soul. Yes, I said to myself, seized by an exalted enthusiasm, I will substitute the truth for this mocking parody, *I will make the blind to read! I will put* *in their hands volumes printed by themselves. They will trace the true characters and will read their own writing, and they shall be enabled to execute harmonious concerts.*' "[4]

More than ten years passed before Haüy was able to reach the goal of printing in relief for the blind. All the early efforts to provide an embossed type were directed toward making tangible the simpler forms of type in general use by the reading public. So long as men with sight worked at the problem, this was the logical thing. Haüy's adaptation was the following (Fig. 108):

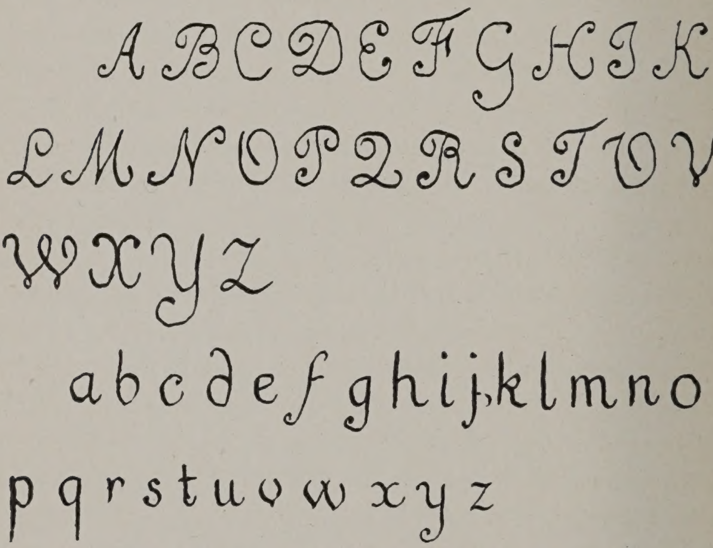
A B C D E F G H I K
L M N O P Q R S T U V
W X Y Z
a b c d e f g h i j k l m n o
p q r s t u v w x y z

Fig. 108.—Facsimile of type used by Valentin Haüy.

The first alphabets used in the American schools were some form of " line type " which were simply modifications of the ordinary fonts used by printers. Two forms were perfected: one, in the Pennsylvania school, known as the Philadelphia Line Type which retained the capital letters and used rounded forms of small letters, in which was produced in November, 1833, the Gospel of Mark, the first embossed book for the blind printed in America; the other, in the Massachusetts school, known as the Boston Line Type, which discarded capital letters and introduced the principle of angularity into the letters in the belief that they were more tangible. These types continued in use until a blind man, Louis Braille, by chance another son of France, devised an alphabet by a purely arbitrary arrangement of dots. The enormous advantage of a " dot " over a " line " system as a medium of instruction lies in the fact that it can be *written* as well as *read,* no practical means having been devised for writing any line system. Braille's system is based upon six dots arranged two horizontally, three vertically, thus ⠿ of which sixty-three combinations are possible. This system was adopted in France, was introduced later into England and somewhat later into the United States. Various modifications of this arrangement have been devised, but the basic principle of Braille's cell obtains wherever education for the blind is provided. One modification, devised by another blind man, this time an American, Joel W. Smith, in use by about one-half of the schools in this country, sometimes referred to as " revised," sometimes as " scientific " Braille, but more generally known as American Braille, is as follows (Fig. 109):

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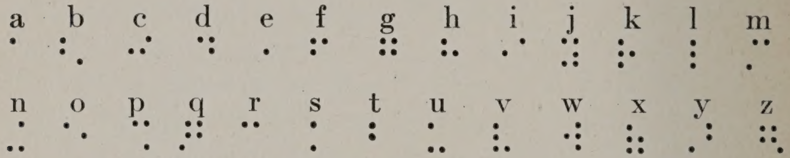
[4] "The Blind as Seen Through Blind Eyes," by Maurice de la Sizeranne, p. 56.

Another modification of Braille's system, known as New York Point, devised by Dr. Russ and perfected by Mr. Wait at the New York (City) Institute is based upon a cell only two dots high, thus : :, which is capable of indefinite extension horizontally. This system was formu-

## AMERICAN BRAILLE

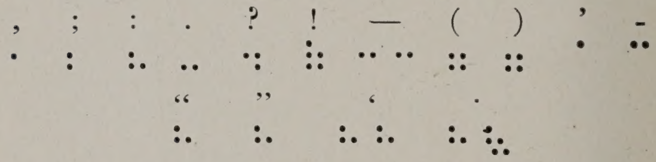
To write on a Braille tablet begin at the right; to read reverse the sheet and begin at the left. In either case the six points ( ⠿ ) of which the characters are formed, are numbered from the top, 1, 2, 3, for the first vertical row, and 4, 5, 6, for the second.

### ALPHABET.



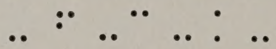
To capitalize a letter prefix to it points 3 and 6 ( ⠤ ).

### MARKS OF PUNCTUATION.



The apostrophe is point 4. The other marks, except the exclamation, are formed of points 2, 3, 5 and 6.

When two or more initial letters requiring the capital sign occur together, the space which separates words may be omitted; the period which follows the first letter then becomes also the prefix, or capital sign, for the next; thus,



F. R. S.

### NUMERALS.

When alone or in combination the following letters, if prefixed by the numeral sign ( ⠼ ) become numbers.

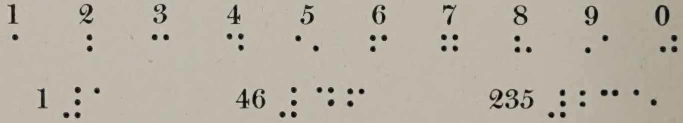


Fig. 109.—American Braille alphabet.

lated earlier than the American Braille and is used in fully one-half of the schools on this continent.

Between these two dot types, the battle of supremacy in America has been waged for a quarter of a century. For about fifteen years a committee of capable blind people has been working for a uniform type with the hope that an agreement with the English can be reached so that there shall be a uniform type for the blind of the English-speaking world. The world war has interfered with the progress of the work for uniformity of the committees appointed in England and America, but it is believed that mutual concessions will ultimately lead to uniformity.

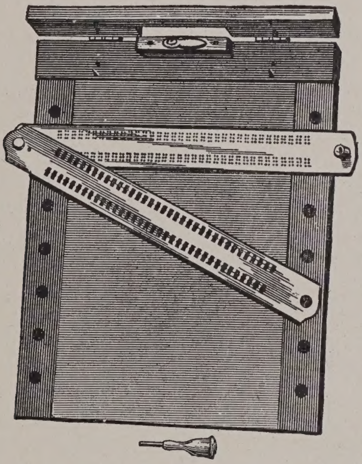


Fig. 110.—Interlining Braille slate.

*Writing* which can be read by the fingers is done by means of a stylus with which the writer pushes the paper into " pits " drilled into a metal base, the number corresponding to the six dots of the Braille cell, the stylus in the writer's hand being guided by cells punched into a metal guide. This method is somewhat slow, as it is possible to make but a single dot at a time, but those who have good use of their hands, with constant practice, write with remarkable speed. A small machine resembling somewhat a typewriter but with keys corresponding to the number of dots in a cell has been invented by which the operator can make an entire character at one stroke. By this it is possible to produce embossed characters with greater speed and facility (Figs. 110 and 111).

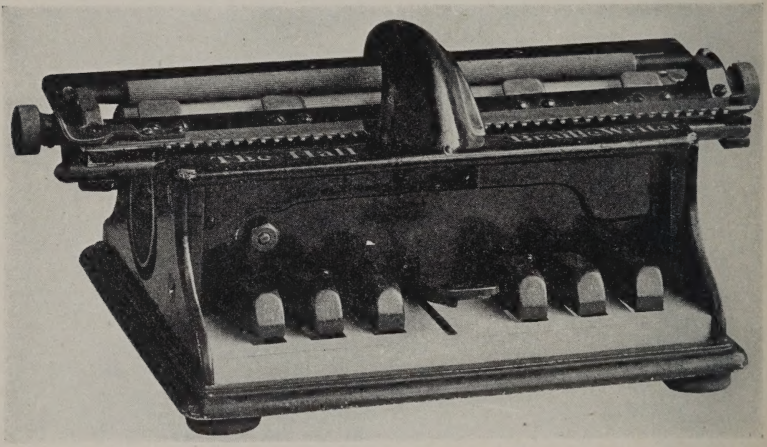
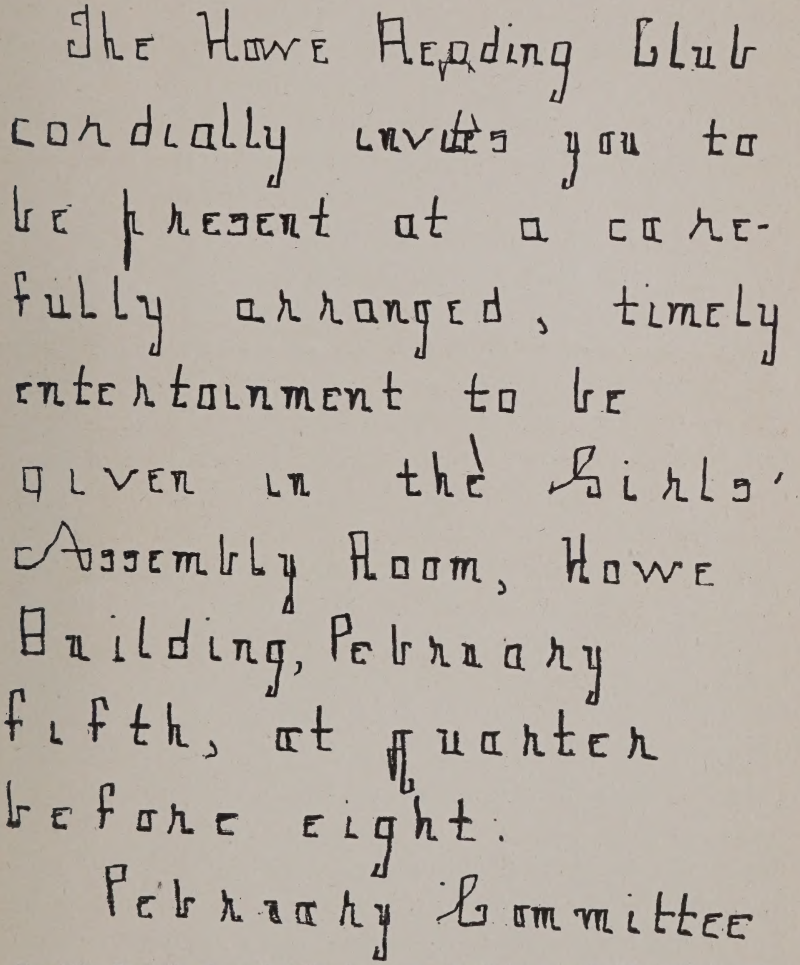


Fig. 111.—Hall Braille writer.

*Pencil writing* can be learned by totally blind people if sufficient time be given to it, but many educators believe that it has insufficient value to warrant the time and effort involved for one who has never seen to learn to produce legible writing, particularly in view of the moderate price of typewriters which can be easily mastered by blind people. Pencil writing has been taught most systematically and continuously in this country at the Perkins Institution now located at Watertown, Mass. That one who has been totally blind from early childhood can produce a perfectly legible letter is shown by the reproduction of an invitation



The Howe Reading Club
cordially invites you to
be present at a carefully
arranged, timely
entertainment to be
given in the Girls'
Assembly Room, Howe
Building, February
fifth, at quarter
before eight.
February Committee

FIG. 112.—Facsimile of pencil writing in "square hand" by a totally blind girl, a pupil of the Perkins Institution for the Blind, Watertown, Mass.

written by a girl pupil of that school, blind since two years of age, who has studied pencil writing about ten years (Fig. 112).

*Languages,* whether English, modern foreign, or ancient classical, can be reproduced for finger readers. It is only necessary to assign dot characters for various accents and modified vowels, or for the entire alphabet as in the case of Greek, and the blind student can become as proficient a linguist as his seeing classmate. The chief obstacles to a wealth of text-books and literature for the blind are the cost of production and bulk of embossed books which is referred to later in this chapter.

*Mathematics* in nearly all its forms is as possible for blind as for seeing students. By means of an arbitrary assignment of characters the ten arithmetical digits and the signs of operation are provided for. In the same manner the need is met for the additional characters necessary for algebra and geometry and the higher mathematics. Short processes in arithmetic and mental arithmetic are most advantageous to the blind student and should be utilized to the fullest extent. Some blind students have done such notable work in mathematics as to seem to warrant the statement that the blind excel in this science; but the truth is there are about the same differences among blind as among seeing students; some excel in mathematics, others in languages—it is a matter of individual taste and capacity, a question wholly apart from the possession of sight or the lack of it.

The elementary facts of *form study* and *drawing* can be taught by special devices. One method is a home-made " cushion "; a shallow box, whose sides are two or three inches deep, is filled with hair or excelsior which is covered with ordinary denim cloth. On this " cushion " the several kinds and sizes of upholsterer's tacks are used for the various kinds of lines.

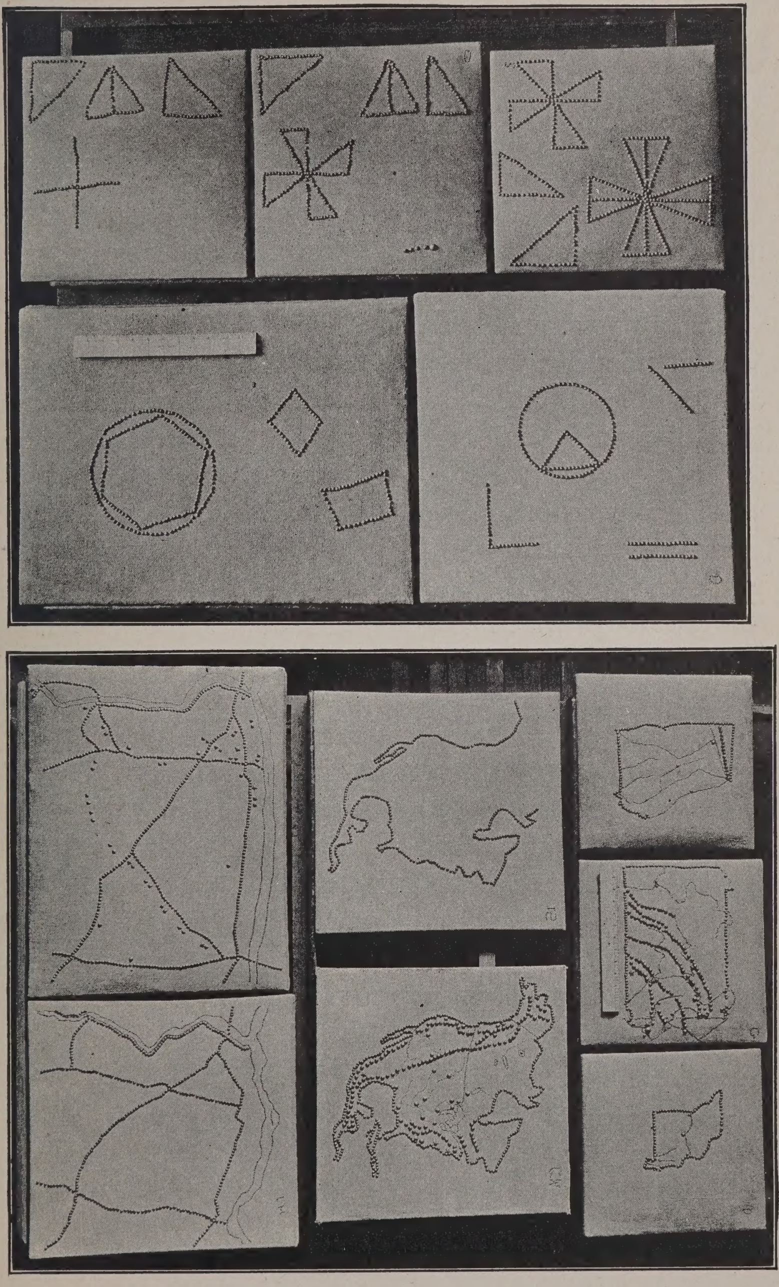


Fig. 113.—Form study and map drawing. By means of upholsterer's tacks and cushions—the work of the girls of our second, third and fourth grades.

It is probably true that no subject in the curriculum of all schools is so generally poorly taught as *geography,* and this is no less true of schools for the blind. The descriptive portions of this subject are as easily taught to sightless as to seeing pupils. But it is exceedingly difficult if not impossible to convey, to those blind from birth or early childhood who consequently have no visual images, any correct notions of the graphical portions of the subject. Outline maps are made on metal plates from which reproductions upon paper are made in sufficient quantities that each pupil can have one under his fingers, but it is doubtful whether the pupil gets any very exact idea from these. In this matter, however, he may be no worse off than the seeing child who, it is well known, acquires singularly incorrect notions from the map. Probably the most satisfactory aids to map study in a school for the blind are the dissected maps which enable the pupil to acquire more accurate ideas of form and relative size. Maps can be drawn by means of the special device for drawing, already described, but the process is so slow and the results are so incommensurate with the labor involved that it possesses doubtful value (Fig. 113).

*History* can be as easily taught blind as seeing pupils. The chief difficulty is the limited number of books which makes impossible any extended reading or research work, except by the few who can afford to employ a reader. But as blind people must get a much larger proportion of their information through the ear than through the eye, some acquire the habit of attention so that they are able to get as much from one reading of a historical or literary passage as many seeing people do from two readings. This power is not, however, to be considered as inherent in blindness;

and in the blind as a class there are the same individual differences in the power of attention as among those who see.

The facts of the various natural and physical *sciences* can be acquired by blind pupils who can follow and even themselves perform many of the simple experiments which seem to require sight. Indeed, an enthusiastic teacher of these sciences can give totally blind pupils a considerable fund of information from clear and detailed description of experiments which the teacher performs in the presence of the class.

*Typewriting* is taught in most schools for the blind, almost every make of machine being used and usable by sightless operators. Shift-key machines are doubtless best, as their keyboards are more compact and liability to errors, due to striking the wrong keys, is reduced by nearly one-half. The blind operator is entirely at home with the "touch system" now generally taught in schools of business; for no other system is possible for him. Contrary to popular belief, no special marking of the keys is necessary; he learns his keyboard precisely as does the seeing operator who learns the "touch system." Blind people can and do learn to write almost without error. The typewriter is the best means of communication between blind people and their sighted friends. The ability to use the typewriter well can be acquired by the expenditure of much less time and effort than is necessary to be able to write legibly with the pencil. Cheapness, simplicity of construction, durability, and portability are the chief desiderata in a typewriter for the blind. The folding typewriter recently manufactured is a boon to them. The chief if not the only argument against the typewriter and in favor of pencil writing is the relative cost; everyone can be supplied with pencil and paper, only the few can afford to own a typewriter. But as second-hand and rebuilt machines can be purchased at a nominal cost, this argument loses much of its force.

It has been demonstrated that a blind person who possesses the other qualifications can do work in typewriting that has commercial value, particularly at such work as typewriting from dictaphone records. Probably no other school in the world has developed so highly efficient a typewriting department as the Royal Normal College for the Blind in London, England. Several graduates of that school hold positions in offices which they have won in competition with seeing typists because of the superior excellence of their work. A few totally blind operators are filling remunerative positions in this country. In order to attain success one must be able to do almost perfect work and be fortunate enough to secure a position where he is not required to file correspondence, but can spend his entire time at typewriting.

The Musical Education of the Blind.—It is popularly believed that the blind are more musical than those who see; but we are no more warranted in generalizing about the musical abilities of the blind than about any other characteristics or abilities popularly attributed to them. So far as the pupils of our schools are concerned, the truth is that the general educational value of music and its particular value to those whose channels of enjoyment and appreciation are restricted by the lack of sight are recognized, and the aim is to provide adequately for instruction along musical lines. In a residential school the atmosphere is saturated with music. There is choral and group singing,

singing at the daily prayer service, individual voice culture for a few of the most talented, instruction in piano playing and, for a few with special talent, in organ playing. Some schools add to these instruction on the violin, guitar, and other stringed instruments. Little wonder is it that in such an atmosphere those who possess musical ability are discovered and provided with the very best musical education obtainable! Music is preëminently the one art in the enjoyment and appreciation of which blindness is no handicap. Here blind and seeing are on a plane of entire equality.

The difficulties are infinitely greater in following music as a vocation. A talented few become church organists; but one must possess superior ability and must put forth almost herculean effort to meet the demands made upon an organist of a modern church. A conspicuous example of a blind man eminently successful as a church organist is the late David Duffle Wood, of Philadelphia, who, though totally blind from early childhood, by the sheer force of will coupled with musical ability, broke asunder the bonds which his blindness imposed upon him and became one of the most eminent musicians of the city in which he lived. After securing his education at the Pennsylvania Institution for the Instruction of the Blind, he became the organist at St. Stephen's Protestant Episcopal Church, which position he held for forty-six years, during twenty-five of which he was its musical director. During much of this time he was a member of the staff of one of the city's best schools of music and he was in constant demand as a teacher of the organ.

The moving picture theatre offers a wider field for musical talent and more remunerative employment, and not a few successful organists have left the church organ bench for this better compensating, if less dignified, field of labor: but to succeed in this field one who is totally blind must have the aid of a person with sight. A still larger number become teachers of the piano; some in schools for the blind, some as private teachers of seeing children. Several schools now provide normal courses for those who have the inclination and the ability to teach, in which the teacher in training is instructed in the methods employed in teaching seeing children and actually teaches them under the supervision of the experienced teachers of the music staff. For blind people who possess the requisite ability, musical

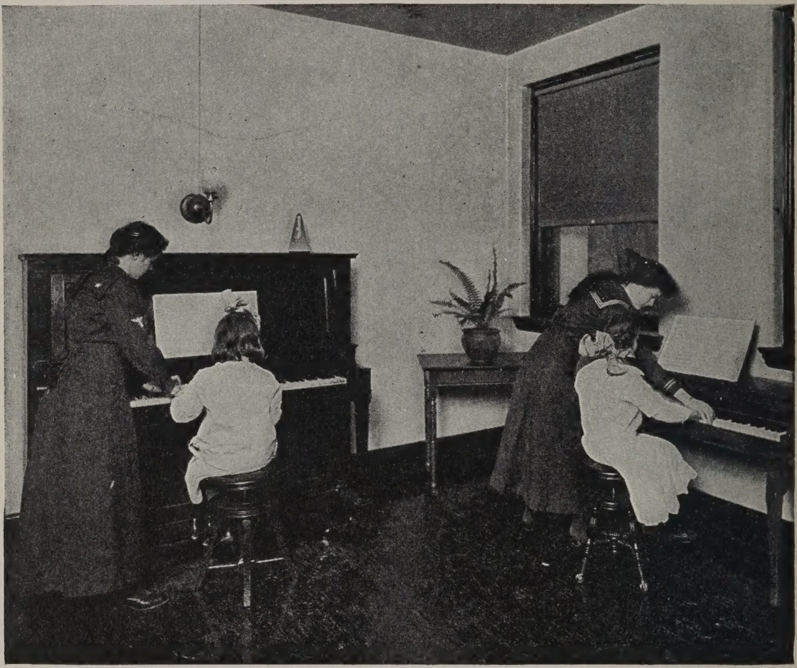


Fig. 114.—Senior pupils teaching seeing pupils. At the clavier and piano.

appreciation, personality and perseverance, the profession of music offers a field for useful and remunerative employment (Fig. 114).

COEDUCATION OF BLIND AND SEEING IN PUBLIC SCHOOLS.—What has been said so far about the education of the blind has had reference to their training in residential schools, which was the only method in vogue until the twentieth century. To the city of Chicago belongs the credit of undertaking, in 1900, the experiment of educating blind children in classes with those who see. This plan was in operation during the school year 1915–16 in at least ten cities in which there were enrolled 497 pupils.

The usual plan of conducting these classes is as follows: A room, equipped with the special devices needed by blind pupils, is placed in charge of a special teacher whose first duty is to see that the pupil masters the devices that are necessary for him to be able to use almost automatically before he can go to the grade room, to which by his age and attainments he belongs, and share in the recitations with his seeing classmates. He must learn to read and to write his dot type, to use his type slate (a special device used by the blind in arithmetic and algebra), and later to operate a typewriter. As soon as he can read and write his dot type he can take part in the recitations in reading, spelling, language, geography, history, and similar subjects. One important and arduous duty of the special teacher is to see that the blind pupil is provided with a reading book and wherever possible with an embossed copy of all the material used by his seeing classmates. The special teacher interlines for the grade teacher his written work in language, history, geography, etc.; for everything must be done to make the blind child a welcome member of the class, and one essential is that he add as little as possible to the duties of the grade teacher having from forty to sixty pupils. As he progresses he can save the time of both special and grade teacher by using the typewriter for his " written " work. As the assistance by the special teacher must be largely individual and as all of her pupils may belong to different grades, the membership of these classes is usually restricted to ten pupils.

While this method is still in an experimental stage it is only fair to its advocates to say that the advantages claimed for it have much to commend it; it keeps the child constantly among seeing children and in the normal atmosphere of his home instead of removing him for a time to a residential school; it places the responsibility for his care and support upon his parents; and it is more economical. Obviously such a plan is possible only in the more populous centres.

This plan, however, violates the two most fundamental needs in the education of the blind which were stated earlier in this chapter, in that it fails to make any adequate provision for the physical and manual training of the pupils. Under this method, too, is lost all there is of value in having pupils continually in a musical atmosphere, and it is much more difficult to provide them with opportunities for serious musical study. In other words, it so far provides chiefly for the literary education of the blind and this it seems to do well. In all fairness it ought to be said, however, that private associations interested in the experiment have done what they could to supply these needs and they have succeeded admirably when the difficulties are fully understood and appreciated. Altogether the plan has much to commend it. Between those who advocate it and those who favor the residential school plan there is no conflict; rather the advantages of both methods are recognized and the ideal arrangement in the minds of the leading advocates of both is that which will give each child, who can possibly avail himself of them, the advantages to be derived from both methods.

THE HIGHER EDUCATION OF THE BLIND.—No institution for the higher education of the blind, corresponding to Gallaudet College for the advanced training of the deaf, has been provided and it is well that it is so. There is substantial agreement even among those who believe in the advantages of the residential school that the period of residence in them should be shortened rather than lengthened. Having been surrounded during ten or twelve of his most impressionable years by his schoolmates similarly afflicted; having been thrown but little, if at all, upon his own resources but accustomed to have all decisions made for him, it is far better for him to secure his advanced training among those who see. Where residential schools are situated near a high school the more capable pupils sometimes attend the high school. A few of the more capable and ambitious attend normal school, college, or university, sometimes as resident students, sometimes as day pupils from the special school. As only those are encouraged to attempt advanced courses of training who are known to possess superior ability, they usually maintain a very satisfactory grade of scholarship. While the embossed printing presses do what they can to supply for these students advanced text-books in tangible type, they must usually content themselves with embossed copies of their texts in foreign languages and mathematics, relying upon readers for the preparation of their lessons in other subjects. In order to aid these worthy young people in obtaining a higher education, six states provide a limited amount of funds that may be expended for a reader or for board and tuition or for both. With his course satisfactorily completed the young man or woman is still confronted with the problem of making his way in the world. Nevertheless, the results are highly encouraging: of 18 young men and women, graduates of one of the three oldest residential schools referred to earlier, who had taken advanced courses of instruction, all are rendering useful service in their chosen vocations and are self-supporting. Lewis B. Carll, an eminent blind mathematician, stood second in the class at Columbia College which his classmate, the late Seth B. Low, led. Capable and worthy young people without sight should receive every possible encouragement to secure a higher education.

Embossed Books for Finger Readers.—When Haüy was providing his pupils with books in a tangible type late in the eighteenth century, when the embossing presses in Philadelphia and Boston began printing soon after the opening of their schools, the process was a very slow and expensive one. Nor was there any material advance in the production of embossed literature until late in the nineteenth century. The adoption of the dot types was soon followed by the invention of machines for producing metal plates which are capable of embossing five characters per second. Early in the twentieth century the rotary press was adapted to printing from these embossed plates. These two inventions have lowered the cost and increased the output of literature for blind readers. But as the demand is small and the books are bulky, the cost of paper and binding is disproportionately high. David Copperfield in one dot type makes six volumes, as large as Webster's Unabridged Dictionary, which are listed at $3.50 each, making the cost of a single copy $21.00. Since 1907 through the generosity of Mrs. Matilda Ziegler, blind readers have been furnished, free of cost, a monthly magazine containing sixty to sixty-five pages. With the adaptation and perfection of existing inventions to printing for the blind the cost of production will gradually be lowered with a corresponding increase in the amount of embossed literature.

Since 1879 the National Government has appropriated $10,000 annually for the production of embossed literature which has been distributed pro rata upon a per capita basis to the various schools for the blind. The Howe Memorial Press, an adjunct of the Perkins Institution at Watertown, has an annual income of about $9000 which it may expend in the production of literature and of apparatus; and a number of schools and associations expend liberal amounts from private funds.

The National Government conferred another great boon upon its sightless citizens through the Department of the Postmaster General by extending in June, 1904, the franking privilege to embossed books sent by a library to a blind reader or by a reader returned to the library. Prior to this time books could be sent only by mail or by express and the cost was so great as to be practically prohibitive. Since 1904 there has been an enormous increase in the circulation of embossed books and magazines (Fig. 115).

THE EMPLOYMENT OF THE BLIND.—Two questions are usually asked by every interested visitor to a school for the blind. His first question is, "What trades and professions are open to the blind?" his second, "Can they become self-supporting?"

He who lives and works among the blind and realizes

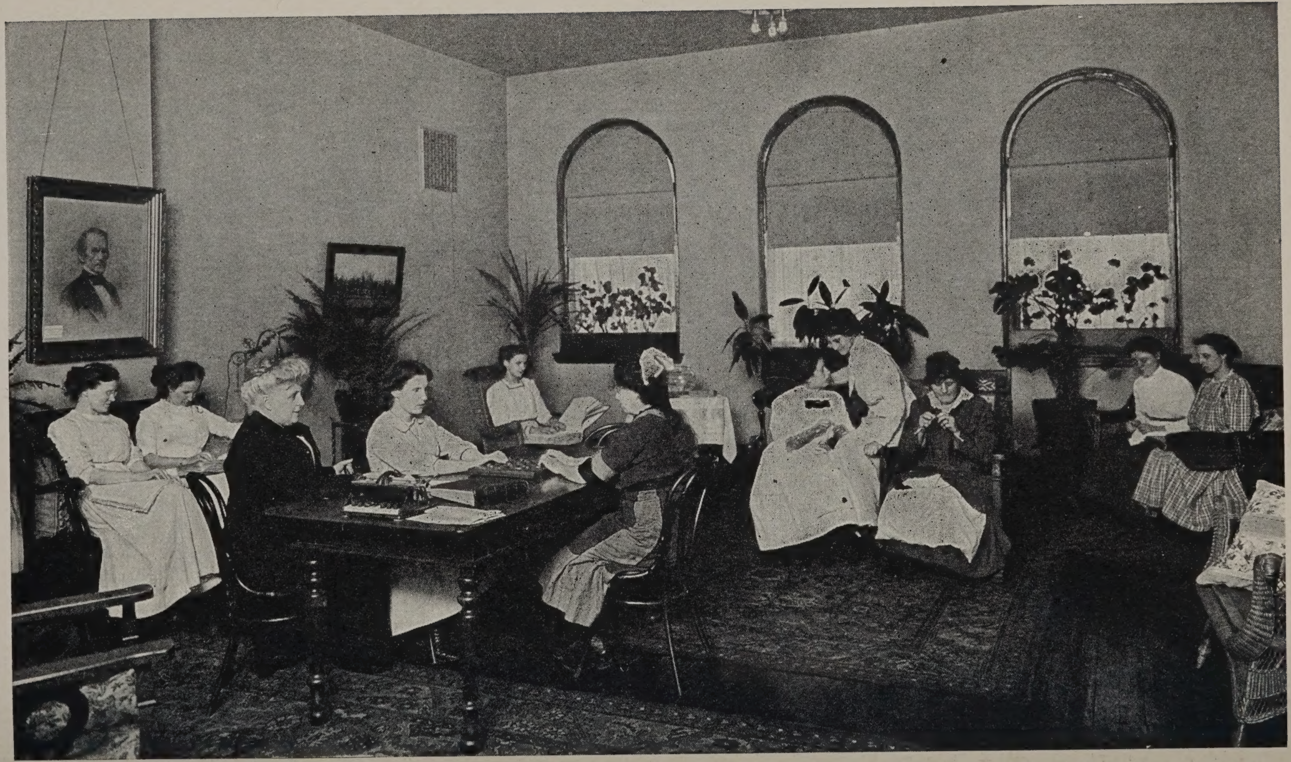


FIG. 115.—Senior girls with their housemother in their cottage sitting-room. After the day's work is over pupils repair to the cottages for rest and recreation. Some are seen here reading, others knitting and crocheting; the two girls at the table are enjoying a game of checkers.

how varied are their talents is almost tempted to reply in answer to the first question: " There are few trades or professions from which the blind are excluded." So many factors enter into the problem that no general answer can be given. In spite of its frequent use in speech and in writing, the phrase " the blind " cannot be used in any generic sense; there is no such concept as " the blind." Persons without sight differ, precisely as those who see, in capabilities, in tastes, in character—in short in all matters that go to make personality. Some have keen intellects, some are dull and almost unteachable; some have a great deal of pride about their personal appearance, others are wholly devoid of any appreciation of its importance; some have strong, sterling characters, others are weak, easily led, and are wholly undependable.

The problem is further complicated by the age at which sight is lost. It is one thing to continue the education of a pupil who loses sight after his education is well begun; it is quite another thing to give adequate training to one who has never seen or who has become blind in early childhood, which is true of three-fourths of those who reach our schools for the blind. To aid the man who loses sight in adult life with a background of years of experience in a world where sight is the queen of the senses in readjusting himself to changed conditions; to show him how he can live and work as a blind man is not an easy task: but to provide the best training and the wisest vocational guidance for those who have never seen is a problem that sometimes seems almost to defy solution. But in spite of the obstacles, success has been won by the blind in many walks in life.

For those who lack initiative or who have found it impossible to succeed without guidance and assistance, industrial homes, which are factories or workshops with a boarding-house attachment, and workshops, which omit the boarding feature, have been found necessary. A few of these are supported by private funds, but nearly all of them receive state or municipal aid. While this method of furnishing employment seems necessary, many believe that every possible effort should be made to keep blind people in their own homes and communities.

Piano tuning has been found to be one of the most remunerative employments for blind men who possess the requisite ear and mechanical ability. Some find this trade a stepping-stone to piano selling and later to successful careers as proprietors of music stores (Fig. 116).

Others of less ability follow simpler and less remunerative employments, such as the reseating of cane chairs, hammock-making, tobacco-stripping, selling newspapers; one man has accumulated a competence by selling peanuts.

Possessed of more ability, some have attained success in business and professional life. Totally blind men and women are successfully practising massage and osteopathy; a young woman, with the help of her mother as a reader, reviews magazine articles and books before women's clubs; another teaches English to foreigners in a large cosmopolitan city; still another teaches vocal music in the public schools of two cities in a central western state. A totally blind man has risen through piano tuning to the presidency of a large piano business, maintaining stores in five Canadian cities; another has acquired affluence as a real estate dealer. Without sight men have attained success and usefulness in the law and the ministry.

Eminent among educators of the blind are the names of two blind men, both knighted by the King of England after forty years of eminent service, Sir Francis Campbell, late principal of the Royal Normal College for the Blind,

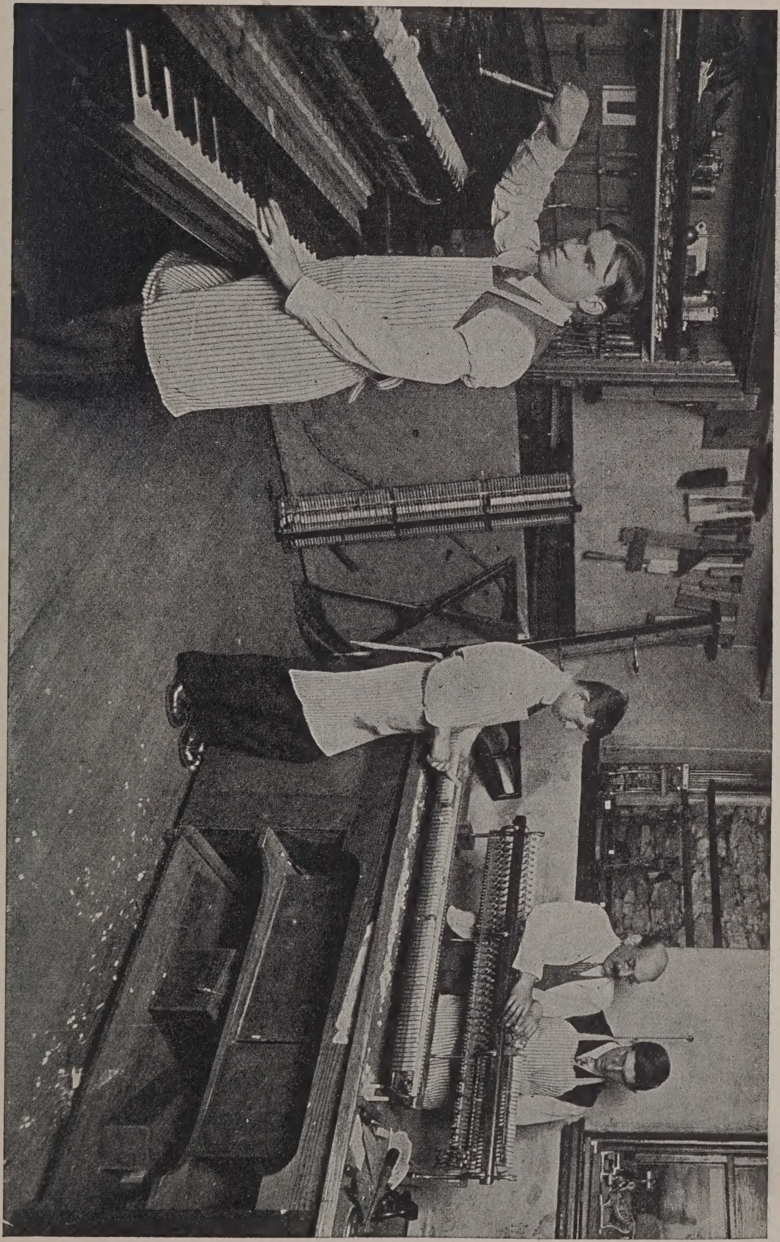


FIG. 116.—Piano tuning and repairing is one of the most lucrative occupations for capable blind men.

London, England, and Sir Frederick Fraser, superintendent of the Halifax (N. S.) School for the Blind; while a not inconsiderable number are individual and class-room teachers, teachers of music and of handicrafts in our schools for the blind.

Blind men are representing their constituents in at least three State Legislatures; the voters of a Minnesota Congressional district recently elected a blind man as their Representative in Congress. Thomas P. Gore, United States Senator from Oklahoma, has been totally blind since fourteen years of age, John E. Swearingen, South Carolina's State Superintendent of Education, has been totally blind from eleven years of age; and Sir Henry Fawcett performed his greatest public service as England's blind Postmaster General.

Nor has the field of literature been closed to the blind. Milton produced " Paradise Lost " after he became blind; though not entirely blind, Prescott and Parkman made their exhaustive historical researches and did their writing almost entirely through the eyes of their assistants, working against odds that would have disheartened most men; totally blind from infancy, Fanny Crosby was the most prolific hymn writer of the nineteenth century; and such was his love for animals and nature and so keen were his observations that Clarence Hawkes before his loss of sight, at fourteen years of age, had laid the foundation that enables him to give us accurate stories of animal life which he does in charming language.

This list of successful blind people could easily be extended; but it is sufficiently long and varied to establish the truth that, while blindness imposes a fearful handicap, it does not prevent the attainment of the highest success and usefulness in many fields of human endeavor.

HE UNITED STATES.—Corrected February, 1916.

| ame | Pupils enrolled 1914–1915 | Superintendent |
|---|---|---|
| Ganey, Resident Supt.<br>utes and Blind, J. S. Graves, | 108 | F. H. Manning. |
|  | 156 | John H. Hinemon. |
| ion of the Deaf and Dumb, and | 94 | L. E. Milligan. |
| e Blind | 37 | W. K. Argo. |
|  | 46 | George H. Marshall. |
| d the Blind | 38 | A. H. Walker. |
|  | 113 | G. F. Oliphant. |
| and the Blind | 18 | W. E. Taylor. |
|  | 210 | H. C. Montgomery. |
| of the Blind | 143 | George S. Wilson. |
|  | 135 | George D. Eaton. |
| ion of the Blind | 97 | Isa A. Green. |
| ion of the Blind | 145 | Susan B. Merwin. |
|  | 60 | G. C. Huckaby. |
| <br>nd and Deaf Mutes | 150 | John F. Bledsoe. |
| ssachusetts School for the Blind | 290 | Edward E. Allen. |
|  | 173 | Clarence E. Holmes. |
|  | 123 | J. J. Dow. |
|  | 78 | R. S. Curry, M.D. |
|  | 115 | S. M. Green. |
| e Blind | 18 | H. T. Menzemer. |
|  | 57 | N. C. Abbott. |
|  | 45 | R. R. Pratt. |
|  | 190 | Charles A. Hamilton. |
| of the Blind | 119 | Edward M. Van Cleve. |
| nd Dumb, and the Blind | 260 | John E. Ray. |
|  | 26 | B. P. Chapple. |
| ion of the Blind | 240 | Chas. F. F. Campbell. |
|  | 91 | O. W. Stewart. |
|  | 38 | E. T. Moores. |
| tion of the Blind | 230 | O. H. Burritt. |
| titution for the Blind | 144 | T. S. McAloney. |
| ion of the Deaf and Dumb, and | 93 | N. F. Walker. |
|  | 29 | Lelia M. Curl. |
|  | 233 | J. V. Armstrong. |
|  | 237 | E. E. Bramlette. |
| d Dumb and the Blind Colored | 55 | J. J. Donaldson. |
| he Blind | 34 | F. M. Driggs. |
| nd | 5 | Helen G. Throckmorton. |
| he Blind | 76 | W. A. Bowles. |
| olored Deaf and Blind | 38 | Wm. C. Ritter. |
|  | 54 | Sadie E. Hall. |
| e Blind | 83 | Parley De Berry. |
|  | 136 | J. T. Hooper. |
| nd the Deaf and Dumb |  | Dept. for the Blind not yet opened. |
| al enrolment, 1914–1915 | 4860 |  |

London, England, and Sir Frederick Fraser, superintendent of the Halifax (N. S.) School for the Blind; while a not inconsiderable number are individual and class-room teachers, teachers of music and of handicrafts in our schools for the blind.

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This list of successful blind people could easily be extended; but it is sufficiently long and varied to establish the truth that, while blindness imposes a fearful handicap, it does not prevent the attainment of the highest success and usefulness in many fields of human endeavor.

Residential Schools for the Blind in the United States.—Corrected February, 1916.

| State | Place | Name | Pupils enrolled 1914–1915 | Superintendent |
|---|---|---|---|---|
| Alabama | Talladega<br>Talladega | School for the Blind, J. S. Ganey, Resident Supt.<br>School for Negro Deaf Mutes and Blind, J. S. Graves, Resident Supt. | 108 | F. H. Manning. |
| Arkansas | Little Rock | School for the Blind | 156 | John H. Hinemon. |
| California | Berkeley | Institution for the Education of the Deaf and Dumb, and the Blind | 94 | L. E. Milligan. |
| Colorado | Colorado Springs | School for the Deaf and the Blind | 37 | W. K. Argo. |
| Connecticut | Hartford | Institute for the Blind | 46 | George H. Marshall. |
| Florida | St. Augustine | Institution for the Deaf and the Blind | 38 | A. H. Walker. |
| Georgia | Macon | Academy for the Blind | 113 | G. F. Oliphant. |
| Idaho | Gooding | State School for the Deaf and the Blind | 18 | W. E. Taylor. |
| Illinois | Jacksonville | School for the Blind | 210 | H. C. Montgomery. |
| Indiana | Indianapolis | Institute for the Education of the Blind | 143 | George S. Wilson. |
| Iowa | Vinton | College for the Blind | 135 | George D. Eaton. |
| Kansas | Kansas City | Institution for the Education of the Blind | 97 | Isa A. Green. |
| Kentucky | Louisville | Institution for the Education of the Blind | 145 | Susan B. Merwin. |
| Louisiana | Baton Rouge | Institution for the Blind | 60 | G. C. Huckaby. |
| Maryland | Overlea<br>Overlea | School for the Blind<br>School for the Colored Blind and Deaf Mutes | 150 | John F. Bledsoe. |
| Massachusetts | Watertown | Perkins Institution and Massachusetts School for the Blind | 290 | Edward E. Allen. |
| Michigan | Lansing | School for the Blind | 173 | Clarence E. Holmes. |
| Minnesota | Faribault | School for the Blind | 123 | J. J. Dow. |
| Mississippi | Jackson | Institute for the Blind | 78 | R. S. Curry, M.D. |
| Missouri | St. Louis | School for the Blind | 115 | S. M. Green. |
| Montana | Boulder | School for the Deaf and the Blind | 18 | H. T. Menzemer. |
| Nebraska | Nebraska City | Institute for the Blind | 57 | N. C. Abbott. |
| New Mexico | Alamogordo | Institute for the Blind | 45 | R. R. Pratt. |
| New York | Batavia | State School for the Blind | 190 | Charles A. Hamilton. |
|  | New York City | Institute for the Education of the Blind | 119 | Edward M. Van Cleve. |
| North Carolina | Raleigh | Institution for the Deaf and Dumb, and the Blind | 260 | John E. Ray. |
| North Dakota | Bathgate | School for the Blind | 26 | B. P. Chapple. |
| Ohio | Columbus | Institution for the Education of the Blind | 240 | Chas. F. F. Campbell. |
| Oklahoma | Muskogee | School for the Blind | 91 | O. W. Stewart. |
| Oregon | Salem | Institution for the Blind | 38 | E. T. Moores. |
| Pennsylvania | Philadelphia | Institution for the Instruction of the Blind | 230 | O. H. Burritt. |
|  | Pittsburgh | Western Pennsylvania Institution for the Blind | 144 | T. S. McAloney. |
| South Carolina | Cedar Spring | Institution for the Education of the Deaf and Dumb, and the Blind. | 93 | N. F. Walker. |
| South Dakota | Gary | School for the Blind | 29 | Lelia M. Curl. |
| Tennessee | Nashville | School for the Blind | 233 | J. V. Armstrong. |
| Texas | Austin | Institution for the Blind | 237 | E. E. Bramlette. |
|  | Austin | Institution for the Deaf and Dumb and the Blind Colored Youth | 55 | J. J. Donaldson. |
| Utah | Ogden | School for the Deaf and the Blind | 34 | F. M. Driggs. |
| Vermont | Brattleboro | Austine School for the Blind | 5 | Helen G. Throckmorton. |
| Virginia | Staunton | School for the Deaf and the Blind | 76 | W. A. Bowles. |
|  | Newport News | Virginia State School for Colored Deaf and Blind | 38 | Wm. C. Ritter. |
| Washington | Vancouver | State School for the Blind | 54 | Sadie E. Hall. |
| West Virginia | Romney | School for the Deaf and the Blind | 83 | Parley De Berry. |
| Wisconsin | Janesville | School for the Blind | 136 | J. T. Hooper. |
| Wyoming | Cheyenne | Institution for the Blind and the Deaf and Dumb |  | Dept. for the Blind not yet opened. |
|  |  | Total enrolment, 1914–1915 | 4860 |  |

# CHAPTER XX

## THE POPULAR MOVEMENT FOR CONSERVATION OF VISION

### By Edward M. Van Cleve

MANAGING DIRECTOR OF THE NATIONAL COMMITTEE FOR THE PREVENTION OF BLINDNESS

"Public health is purchasable; within natural limitations a community can determine its own death rate." This is the forceful declaration of the City and State Boards of Health of New York. Its truth is being accepted and proved more generally all the while. The corollary that human powers can be conserved by taking thought is capable of demonstration in similar fashion. In the field of conservation of vision this truth is accepted, that correct knowledge of the means of avoiding harm to the eyes is the surest road to saving sight, and the only purchase price that is demanded is the effort made in securing that knowledge. It is monstrous to think that any parent is willing to let his child go blind if he knows the condition that will inevitably bring on this calamity and knows the means of prevention. For his child he will buy at any cost safety from so great a calamity as losing sight. Enlightened self-interest will lead the individual to care for his own eyes.

The movement for the conservation of vision is to-day an educational movement concerning itself with bringing to general attention the knowledge of specialists in saving sight for the individual threatened or already in peril, that society may be spared the increase of inefficiency through the addition of handicapped men and women, and that the public burden of providing for such handicapped persons may be lessened. Conservation of vision is first a personal interest; it becomes a social interest, even a public interest.

Whoever learns that half of all blindness is preventable experiences some sort of emotion. It may be only a mild wonder why somebody does not do something about the matter, or it may assume the opposite extreme of a burning indignation or a divine pity inspiring action—vigorous, persistent, effective. The discovery of Credé, in 1881, that the instillation of a solution of a silver salt at the time of birth in the eyes of the new-born babe will almost invariably kill the germ which produces much blindness and impairment of vision in babyhood, gave rise to widespread discussion by physicians and an effort to secure the general use of the so-called Credé method. Success in reducing to a minimum the cases of visual impairment, by this or a similar method, wherever used, has given life to the endeavor of organizations and interested individuals to make it a matter of universal knowledge that blindness from inflammation in the eyes of the new-born is needless. To accomplish this education of the public, recourse is had to the newspaper, the popular magazine, the printed leaflet—all the devices of advertising; also to the popular lecture and the moving picture.

Other causes of blindness or reduced vision in childhood claim attention. Ocular tuberculosis, interstitial keratitis, eye troubles following measles and scarlet fever, sympathetic ophthalmia, and progressive near-sightedness are chief of these. Intelligence in handling these diseases comes from spreading knowledge of their danger and directing their victims to proper care.

Trachoma attacks both child and adult. It thrives in ignorance and neglect. Glaucoma in adults comes on insidiously and the warnings of its approach are neglected because unrecognized. In the industries, in the schools, in the home, eye-strain is endured without consideration of its calamitous effects. Yet all of these causes of visual impairment may usually be avoided. It is the purpose of the societies organized for the conservation of vision to bring about universal knowledge of these facts.

The National Committee for the Prevention of Blindness[1] is engaged in this work of educating the public. It serves as a clearing-house of information for all persons interested in this effort to save sight. It prepares popular literature and publishes it or furnishes the material for articles to magazines, newspapers, and to individuals. It has a large collection of lantern slides for use in illustrating lectures on the subject of conservation of vision. It provides a lecture service by its own staff and lends assistance to lecturers seeking help in preparing to present the facts. It aids in the organization of societies and committees in states and cities, it advises in the passage of laws, it provides expert service in every field for promotion of this cause (see Figs. 117 and 118).

The American Medical Association, through its Committee on Health and Public Education with a sub-committee on Conservation of Vision, secures publication of pamphlets on many subjects concerning care of the eyes, and provides for the press of the country a news service which is widely used. This committee also promotes legislation and maintains a lecture bureau for instruction of the people, using the unpaid services of public-spirited members of the medical profession.

Superintendents of schools for the blind, who are in a position to know how much the blindness that is preventable costs the individual and the State, have been active in the task of spreading the knowledge of possible preven-

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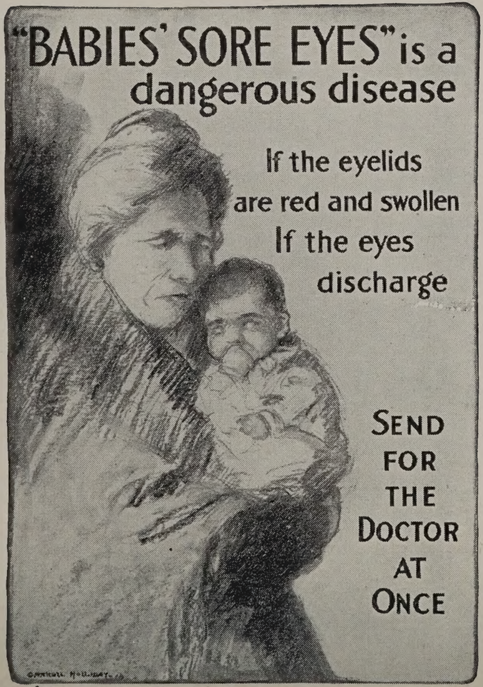
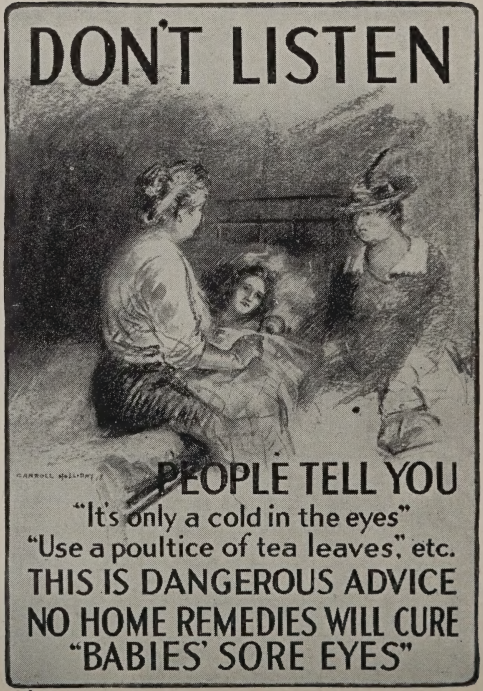
[1] This Committee has its office at 130 East 22d Street, New York City.

Fig. 117


"BABIES' SORE EYES" is a dangerous disease
If the eyelids are red and swollen
If the eyes discharge
SEND FOR THE DOCTOR AT ONCE
CARROLL HOLLIDAY

1 National Committee for the Prevention of Blindness, Inc., 130 East 22d Street, New York, N. Y.

Fig. 118


DON'T LISTEN
PEOPLE TELL YOU
"It's only a cold in the eyes"
"Use a poultice of tea leaves," etc.
THIS IS DANGEROUS ADVICE
NO HOME REMEDIES WILL CURE
"BABIES' SORE EYES"
CARROLL HOLLIDAY

4 National Committee for the Prevention of Blindness, Inc., 130 East 22d Street, New York, N. Y.

tion. For years the publications of the schools for the blind have included directions for prevention of needless blindness.

Societies, committees, State commissions, and interested individuals have undertaken not only educational work but remedial effort. An example of the sort of service that may be rendered is shown in the admirable " follow-up " work possible in Boston through the coöperation of several organizations. Thus, a case is reported by an agent of the Commission for the Blind or by doctor or nurse to the Board of Health which sends a city nurse to investigate. If necessary, the child (and sometimes the mother with the child) is transferred to the Eye and Ear Infirmary for treatment and care, and the hospital through its social service department helps the mother and visits the family after the child's discharge to see that the directions of the doctor are carried out. This kindly care is kept up until the result aimed at is attained—a well child. Such " follow-up " work is very important in cases of ophthalmia neonatorum, but it is also valuable in other kinds of eye trouble, and the social service department is coming to be considered an indispensable part of any well organized hospital, including general as well as special hospitals.

Such is the character of the work done in the movement for conservation of vision. That success is attending the efforts of the workers is evidenced by a gradual but steady lessening of the number of children entering the schools for the blind who have been rendered sightless through preventable causes. For many years, however, effort must be continued and the scope of the work broadened until there is wiped out the reproach on our civilization of allowing any person to go through life with sight lost or seriously impaired from preventable causes.

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